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SMITHSONIAN DEPOSIT

Riter-Conley Manufacturing Company

STEEL CONSTRUCTION

Pittsburgh

THE UNITED GAS IMPROVEMENT COMPANY,

PHILADELPHIA.

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BUILDERS OF

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

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ACCURATE MEASUREMENT

OF

AIR AND STEAM SUPPLY

(PATENTED),

AFFORDING { PERFECT CONTROL OF GENERATOR FIRE CONDITIONS.

PRODUCING { UNIFORM RESULTS. HIGHEST EFFICIENCIES.

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ACCOUNTING.

By Mr. A. P. Post, General Auditor, American Gas Company.[1]

ANALYSES OF STATEMENTS--UNITS OF COST

The classification of accounts has been a subject of much discussion in utility circles since the adoption by the American Gas Light Association of a uniform system of accounts for gas companies. The Interstate Commerce Commission, and the several State Public Utility Commissions have enforced the adoption of systems and classifications that make possible annual reports suitable to their purposes. The National Commercial Gas Association through its Accounting Committee last year revised the grouping and treatment of New Business and Jobbing Revenue accounts. It is gratifying to know that the American Gas Institute in the recently adopted improved System of Uniform Accounts has incorporated the classifications recommended by this Association.

Nor have definition and illustration of accounts been all that attracted attention during recent years. Books, index schemes and office appliances of different kinds have been studied and recommended—types of consumers' ledgers, conduct of cashiers' cages, systems for store rooms, purchase books, voucher registers, payrolls and many other details have been discussed in conventions, committee and employees' meetings, publicly and privately. Public accountants have been engaged to install systems, specialists in cost accounting have been put on the payrolls, and the members of office forces have been carefully selected and trained along proper lines; and all this to the end that efficiency might be attained with accurate bookkeeping results. It almost seems the subject has been so thoroughly covered that further discussion must be mere repetition.

Accounting, however, since the active advent of utility commissions, has taken on a significance new and important. These regulative bodies have at times disregarded a company's books of record, and by independent detailed appraisal determined the value of existing equipment. Upon this value a certain percentage of net earnings has been permitted, and rates that were to be charged to consumers have been adjusted to conform with the percentage so permitted. It will be noted that the valuation of the property was determined independently of book records; but that net earnings which were the basis of adjustment of the new rates, were taken solely from the books of account kept by the company! This does not mean that records of extensions and betterments are of less importance—commissions show considerable interest in new issues of securities and, therefore, are very watchful of increased amounts in improvement accounts—but that records of net earnings are receiving particular attention. The step from regulation of rates (dependent upon net earnings) to regulation of operating expenses is not very great; and there are well-posted men who believe that in the near future regulating operating costs will be as much the work of Commissions as regulating rates is now. Whether that day comes sooner or later or at all, public utilities are finding it necessary to pay more and more attention to operating expenses, and the time that has been spent developing accounting systems will be found to yield as valuable return as the same amount of energy devoted to any other part of the business—that is, if the companies are really taking advantage of all the benefit that is inherent in good accounting methods.

Assuming that some monthly system of operating report is used, the question arises, is the information contained therein viewed in a perfunctory routine sort of way, or is the monthly story of progress taken rigid hold of by managers, analyzed thoroughly and criticized, and then used as a basis for definite retrenchment or extension? Have units of cost been worked out and studied as seriously and regularly as they should have been? Has data been compiled along every practical line so that the engineering work in operating has been reconciled with accounting? A few items, here and there, have undoubtedly been worked up, depending upon the particular hobby of a manager or superintendent, but it would be interesting to know to what extent statistics of real value are built up and used by executives in administering the affairs of gas operating. From what has been written and said on "costs per thousand"—an observer might conclude that with this common unit of cost gas operating expenses begin and end. They may and probably do in reports, and while in manufacturing cost they are all important, they do not have so much significance in the other steps of operating, if taken solely by themselves. For example, to say that advertising cost "$.005$ per thousand sold," or soliciting "$.01$ per thousand sold," really means nothing. To state that a certain gain in gas output due to advertising and soliciting was obtained, and that it cost "25 cents or 30 cents per thousand gained," expresses a unit of cost that does mean something.

It may be interesting to discuss briefly a few of the items that, by some companies, are studied from entirely different angles than the time honored "cost per thousand." Removing and setting of meters is a routine activity that entails a cost distinct from increase or decrease of sales. If output drops, the total dollar cost of removing and setting may increase because of large numbers of removals. If output expands, the total dollar cost of setting may again increase because of brisk orders to set meters. Of what good then, is the unit "per thousand?" Dividing the total dollar cost of removing and setting meters, by the number of meter changes, however, does give an operator an idea as to whether this line of expense is reasonable or not; at any rate, an idea of cost on such basis is more likely to receive studious consideration because of its individuality, the unit being from sources solely within the scope of the work done. When studying the cost of removing and setting meters, cubic feet of gas consumed is not a factor.

Work on consumers' premises—other than merchandising and jobbing—is a distribution expense that when expressed in "cost per thousand" does not convey an intelligible message. Whether called Complaints, Gratuitous Work, or Customers' Premises Expense, the amount charged to this step in operating cost does not greatly depend upon the quantity of gas used by the individual consumers, and comparison between companies or periods based upon output might be misleading, A better unit in this case would probably be "Consumers' Expense, per meter in use." Even this unit is ultra-comprehensive, but with the variety of jobs and wide scope of service covered by these accounts, the cost per meter undoubtedly means more than the cost per thousand.

Overhead items, like Superintendence under the group of Distribution Costs, may be of little significance on the "per thousand" basis. The ratio that cost of supervision bears to the cost of the labor it supervises, does reflect the economical or extravagant character of the work of a department; for when it is stated that of the whole amount of labor, superintendence reaches 10 or 15 or 20 per cent., an operator can intelligently judge the propriety of

1, Paper read at N. C. G. A. Convention, Minneapolis.

his cost of supervision. This view of supervision suggests several ways of showing labor costs. These, while undoubtedly of major concern in operating utilities and the cause of continuous study, are not the subject of as frequent tabulation as would be profitable. Because, for illustration, the wages of the distribution department are charged directly to the various distribution accounts, it has been observed that managers are not infrequently ignorant of even the approximate amount of money that is paid for the operating expense portion of the distribution men. The cost per thousand sold of distribution wages is probably unknown to some heads of departments to whom such knowledge might be of benefit, and the cost of distribution wages per meter in use, and per mile of main are similarly outside the scope of periodic investigation. These units of cost, if regularly compiled, might easily become the cause of needed retrenchment, of increased labor efficiency.

The cost element of the accounts embraced in the Merchandise and Jobbing Revenue group, is held in particular significance by the members of this body. Prices at which appliances are sold are more and more following the line of cost of handling them. The purchase cost, plus store room charges, stable or auto expenses and labor entailed in installation, are factors considered in price making, and the direction toward self-supporting mercantile departments is adhered to more rigidly than a few years back. To this end, systems have been devised that show upon the completion of every job the profit or loss involved; the cumulative results over a period of time being the sole factors considered in price revision.

Commercial expense, using the term to cover office, meter reading and collection costs, also have limited value when shown on the "per thousand" basis. Material increase in commercial costs does not necessarily follow substantial gain in sales per meter in use, but the decreased costs per thousand sold that would obtain under this condition would lead to the belief that the department is gaining in efficiency; whereas, perhaps duplication work, unwieldly methods and incompetence might be characteristic of the office organization. Moreover, one company with high sales per meter, and another with low sales per meter, could not be equitably compared in commercial costs on the basis of costs per thousand sold, because of the difference in the respective distribution efficiency of the two plants. Comparison from the standpoint of meters in use, however, whether working out office salaries, meter reading or expense of collections, is readily accomplished, and because of a fair premise, conclusions deducible therefrom are logical and useful. Examination of the costs of commercial departments of 20 companies showed the mean and extreme cost to vary 8 cents "per M cubic feet sold"; but only 5 cents "per meter in use"! These figures seem to prove the inadequacy of final judgment based upon costs per thousand. It may be apropos to note that departments seemingly highly efficient in the light of sales, were found quite inefficient when the more practical units of costs "per meter in use" was employed.

There are quite a number of accounts that can be handled to good advantage along this general line of thought. It is certain, however, that many utilities have not run down specific costs, and it might be possible to add to their already practical and successful management a series of periodic statistics that would give scientific basis for business judgment. For syndicated utilities comparisons on workable bases may be established, and for properties operating without inter-company relations comparisons for different periods would be valuable.

The downward tendency in units of income, and the upward tendency in the costs of materials and labor have to be met by eliminating waste of materials, and exercising of vigilance in employment of labor. Increased output through a distribution system of a given capacity means efficiency in operating, but no more than a decrease in unit costs of specific work means the same thing. The unit of income is standard, and is so simple and true a unit, it cannot be assailed—a certain revenue per thousand cubic feet of gas sold. Since the test of successful operating is not "what is the gross income?" but "what are the net earnings?"; and since net earnings are no less controlled by operating expenses than by operating revenue, it follows that standard unit of cost are as logical as standard units of income. The gas companies throughout the country have satisfactory accounting systems, or should have after the years of discussion on the subject—they are adequate as a source of statistical research; the need of conservation of income furnishes ample motive, and desire for efficiency demands exact information. In no sense need "costs per thousand" be abolished or disturbed, but it appears they might be supplemented by data that bear more intimate relation to actual costs, that specific instead of general units should be established; and that accounting therefore should not give only mere dollar records of past performances, but also furnish scientific basis for future business programs

Lengthening the Educational Perspective.

[By LEE GALLOWAY, Ph.D., Director of the N. C. G. A. Educational Courses.]

Plato taught that the laboring class could dispense absolutely with all kinds of education. In fuedal times only the clergy and some among the nobility could read and write. In Germany, whose school system was the model for America, universal elementary education began only after the wars of Napoleon. Twenty-five years ago in some of the States of the South it was thought a crime to teach a negro to read and write.

The United States has set the example of democratization of education for the whole world. The public schools are effective in many ways, but they do not give vocational preparation for life work; too much emphasis has been put upon a *general* education. Under our changing conditions, changing ideals are inevitable. Science and mathematics have been made over; only a quarter of a century ago the new science of biology arose. We have the great law of evolution as well as the great principle of self-activity. There is a new industrial order with new problems for solution. The new education, to be truly effective, must be more truly democratic. A democratic education must include preparation for life work, not only in law, medicine, pedagogy, etc., but for all walks of life. The educational perspective must be lengthened so as to give individuals in the trades and industries equal opportunities with those in the professions.

The new education is a matter of new ideals rather than practice. Contemporary conditions demand educational readjustments which will eliminate incapacity, waste and failure. The new education must be democratic, flexible and purposeful enough to give each individual an opportunity to make the most of himself, while contributing something tangible in service to the community.

The free elementary and high schools offer elements of a general education, but they do not give vocational training. The majority of children leave school at 14, 15 or 16 years of age (the compulsory limit) and are consequently not fitted for any particular occupation. Youths drift about from errand boy at the grocery store to elevator boy in an office building, or to some other "job" requiring unskilled labor. Perhaps he gets into a shop and is given work that requires no thought, learning to handle a single machine or operation, with little chance for advancement. If he has latent possibilities, often they are not allowed to show themselves. Here is the great problem. The public school leaves about 75 per cent. of its pupils without training for life work. Manufacturers are continually saying that if they could only get all the skilled workmen they need, they could increase their business. Foremen are equally scarce. What is the solution?

There is only one solution—vocational training. I may be asked "What is vocational training?" "Is it different from general education?" It is a broader term in a sense, although, of course, general and vocational training are allied. By general education, we mean the common cultural studies taught in the schools. A general education is of great use in vocational training, but it is not enough. Vocational education includes all kinds of specialized education meant to fit for definite, useful work. *Industrial* education is a narrower term, including only the trades and industries, *vocational* training embraces all kinds of preparation—agricultural, industrial, commercial and professional. Vocational education must furnish or relate itself closely to the acquiring of practical experience. Master craftmanship must be the object, as well as general all-round development. A good citizen is more useful to the community if he is important in his vocation.

Until vocational education in its true democratic sense is taken up by the public schools, it remains for employers of labor to solve the problem. Company and association schools are doing great work as democratising factors in education. Through their efforts the educational perspective is being lengthened. By giving an opportunity for each individual, from the office boy to the manager, to perfect himself, they are establishing the democratic ideals of the new education.

The National Commercial Gas Association offers opportunities for both general and vocational training of gas employes, under the direction of experts qualified by experience and training, through the new educational courses which begin January 1st next. A commercial education, as that of the man of letters, should go on forevor. The example of the head of the firm will do much toward establishing standard for his employees. It will make them realize the necessity of a high standard of intelligence and a wide range of business knowledge.

TESTS OF A NEW RECORDING CALORIMETER.

By C. H. Stone and W. H. Hinman.[1]

The increasing use of the calorific test as a measure of the value of gas to the consumer renders highly desirable the construction of an instrument that will give a continuous record of thermal value. Such an instrument must be: (1) accurate within reasonable limits; (2) independent of fluctuations in gas pressure; (3) easily standardized; (4) as free as may be from complicated or breakable parts; (5) capable of registering gross or "observed" B.T.U.; (6) simple enough to be operated by men of moderate ability.

There are at present 6 recording calorimeters on the market, *i. e.*, the Smith, the Simmance-Abady, the Sarco, the Leskole, the Junkers and the Fèry. Of these, only the Junkers, Simmance Abady and Sarco have received any degree of favorable notice in this country. The last two do not directly determine the heat units, and (at least in their original form) only the net value is obtained; while the Junkers has not seemed satisfactory where tried. It appears, therefore, that there is room for another and more efficient recording calorimeter; and the American Meter Company has, for about a year, been experimenting in this direction, and has produced the instrument whose tests are here described. This calorimeter is not as yet perfected, and various minor changes may be found desirable, but we believe that the principle is sound, and, therefore, publish the following tests to apprise the gas fraternity of the progress made, and in order to profit by the criticisms and discussion which we hope this paper will evoke.

The instrument consists of a regular Hinman-Junkers calorimeter fitted with a pair of special recording thermometers, and the usual meter, balance, glass thermometers, and governors before and after the meter. An overhead tank is required and under this the calorimeter is firmly mounted. Each recording thermometer consists of a tube about 10 inches long and ¾-inch in diameter, filled with mercury, and connect with the recording mechanism by means of a capillary tube. The change in volume of this mercury due to variation in temperature, causes a motion in an iron spiral similar to the motion produced in a spiral steam gauge by change in pressure. This motion is transferred by levers to a pen which records on a vertically moving chart driven by clock-work. As at present constructed, the difference between the lines of the inlet and outlet pens show the rise in temperature of the water passing through the calorimeter; but it is hoped that eventually the chart will read direct in B.T.U. A continuous supply of water is necessary, and also means of maintaining this at or near the temperature of the room. Tests can be made with this instrument exactly as with an ordinary flow calorimeter at the same time it is serving as a recording device.

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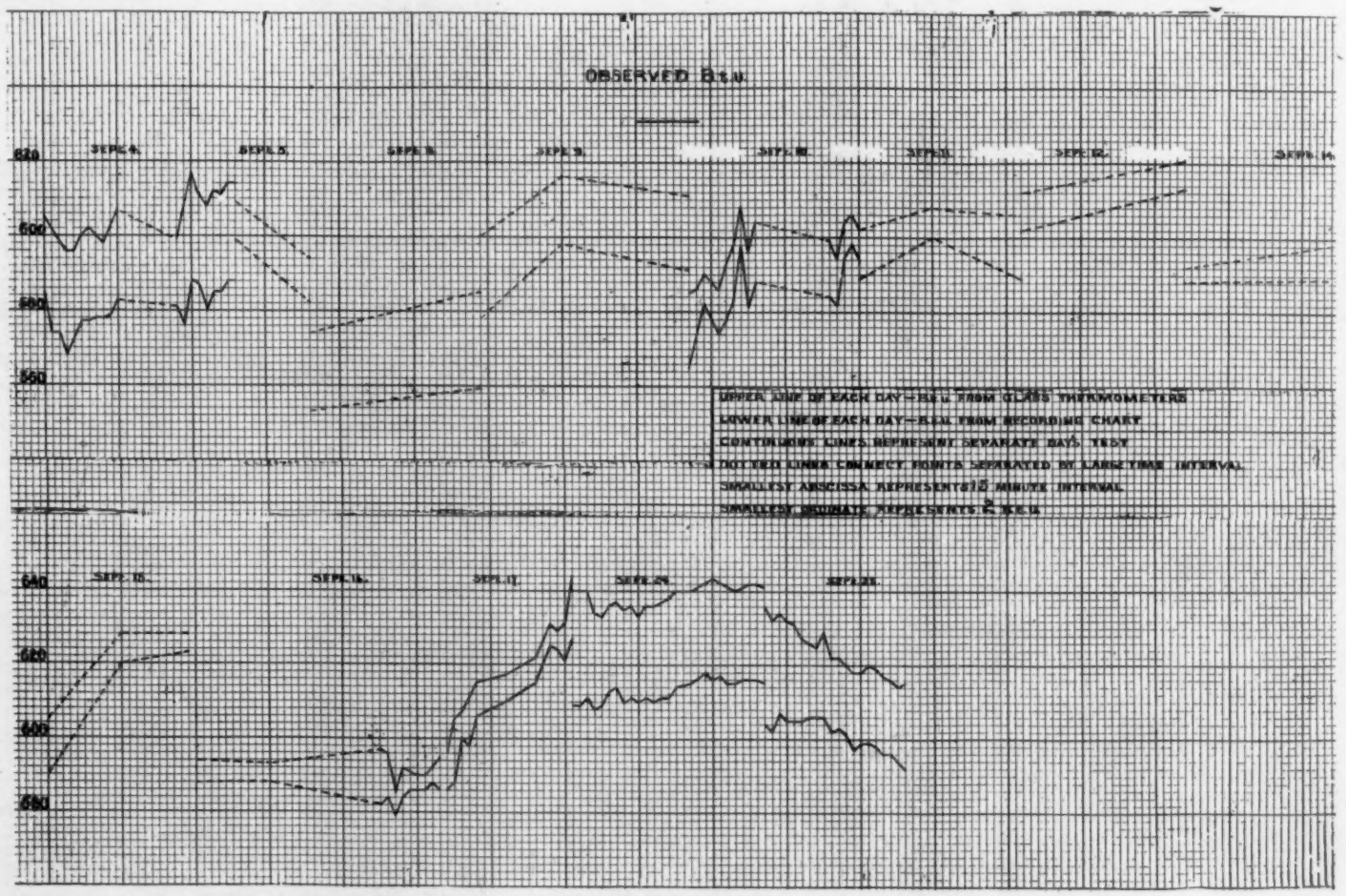

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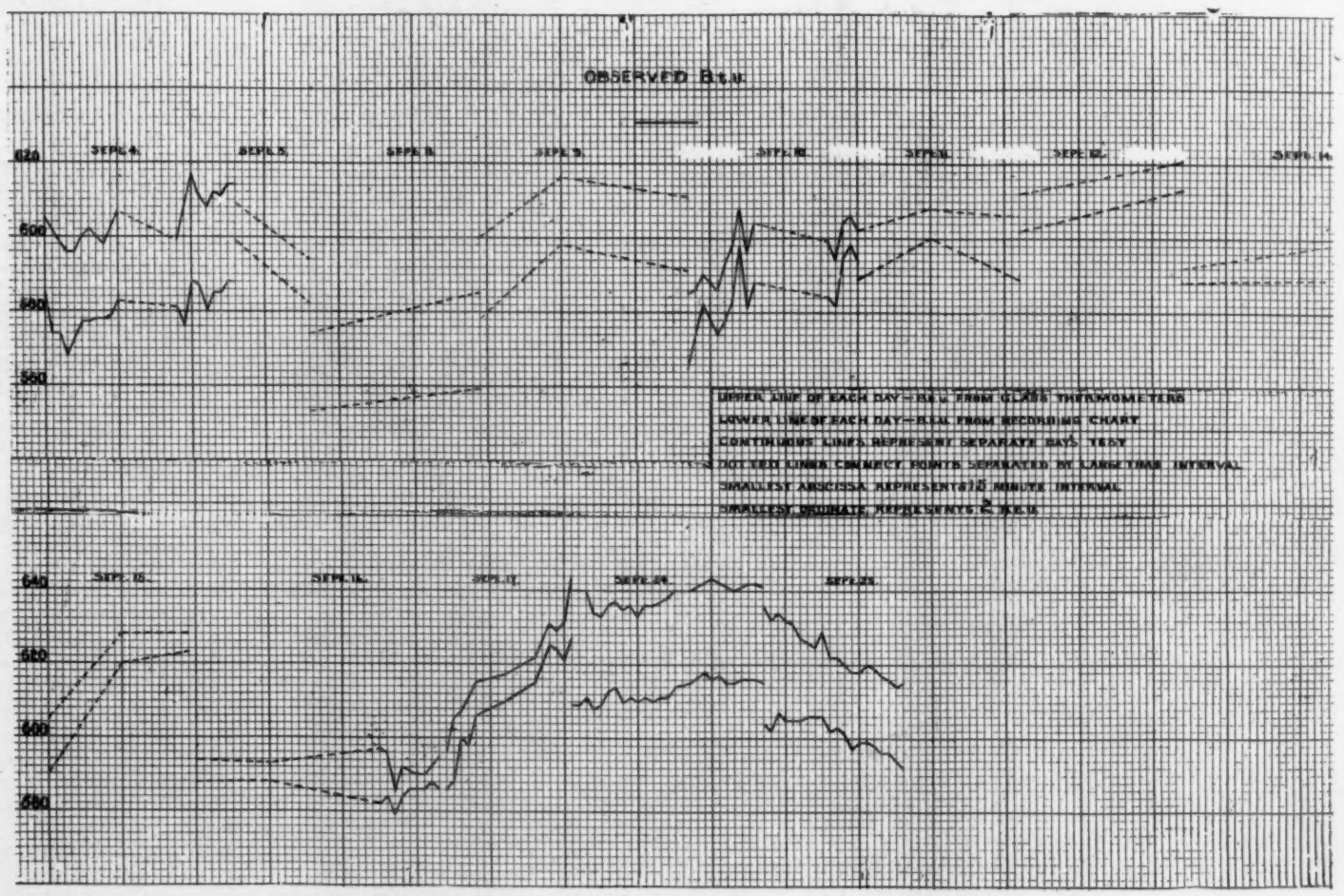

Fig. 1.—Record of Observed B. T. U.

1. Paper read at A. G. I. Meeting, New York.

middle of the day a similar test was made on the recording calorimeter, and again at the end of the day, the latter being followed by two more tests on the Sargent calorimeter. On the 6 special days mentioned, the humidity, specific gravity and B.T.U. in condensation were also determined.

It will at once be seen that 3 factors determine the success or failure of this instrument: (1) Constancy of gas rate; (2) uniformity of water rate; (3) accuracy of recording device. For a considerable time we experienced great difficulty in securing a constant gas rate. After investigating all possible sources of trouble, the disturbing factor was finally located in the valve of the balance governor and in some slight irregularities in two of the wet meters the entire apparatus would have been ruined. This may emphasize the need of a *constant* water supply and the benefits of a tank of large capacity kept always full.

We had little or no trouble in maintaining the supply of water at, or very close to, room temperature. A Doylair water heater was used, and after a little practice, this and the water supply could be adjusted in 5 minutes to maintain uniform temperature throughout the day. If the room temperature is liable to change 3 or 4° during the day, the water supply can be 1 or 2° warmer than the room in the morning, and will thus never be more than 2° in error; or the heater can be readjusted to correspond to the increase in room temperature.

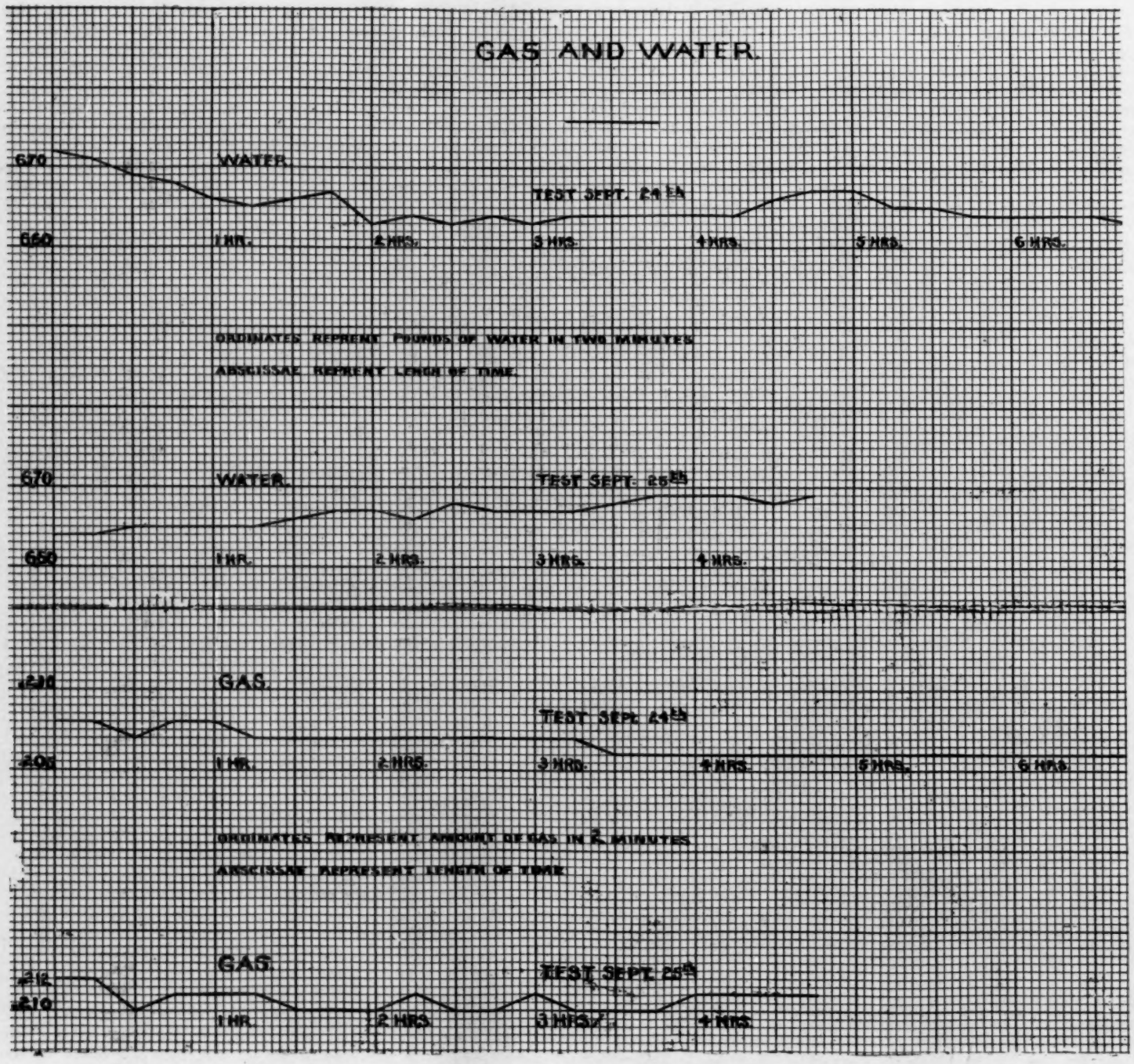

Fig. 2.—Variations in Water and Gas Rates.

tried. On substituting a new governor and a third meter, a gas rate was obtained constant within 1 per cent. A uniform water rate should theoretically be much easier to secure than is a constant gas rate, and we found this to be true, provided all the air in the water passages of the calorimeter was expelled. This expulsion was accomplished by alternately closing and opening the quadrant cock on the inlet 10 or 12 times. The 60-gallon tank was provided with an overflow and care was taken to see that this was always running. On one occasion, the city shut off the water without notice, and had it not been for these precautions and that one of the authors happened to visit the testing room at just the right time,

The recording mechanism required practically no attention, save for filling pens, winding the clock and setting chart; and while its accuracy will be discussed later, the device in general appears to be a success.

In the results which follow, we have plotted all the B. T. U. figures obtained and the chart (Fig. 1) is in large measure self-explanatory. It was thought best to start each day's plotting separately, and thus the line is broken at the end of the day. The upper or black line represents the result obtained by operating the instrument by hand, and the lower or red line gives the results at exactly the same time, but taken from the chart. Where only 2 or 3 tests were made

Table of One Day's Tests.

Time.	Chart Temperatures, Inlet.	Chart Temperatures, Outlet.	Glass Therm. Temperatures, Inlet.	Glass Therm Temperatures, Outlet*	Rise in Temp. Chart.	Rise in Temp. Glass Thermom.	Sec. for 2 Revol. of Meter Hand.	Lbs. Water in 2 Minutes.	Temp. of Gas,	Temp. of Exhaust.	Temp. of Room.	Barometer.	Pressure at Meter. Inches of Water.	Pressure at Burner Inches of Water	Humidity per cent. by Hygrodeik.	Humidity per cent. by Sling-psy.	Corrected Gas in 2 Minutes.	Observed B. T. U. from Chart.	Observed B. T. U. from Glass Therm.	Diff. in B. T. U. of Chart from Glass Therm.	Per Cent. variation from Glass Therm	Specific Gravity.
9.15	70.65	89.85	71.13	91.34	19.20	20.21	90.2	6.64	72.0	73.0	70.0	29.45	1.7	1.05	66	58	0.212	604	636†	—32	5.0	0.632
9.30	70.80	89.95	71.28	91.40	19.15	20.12	90.0	6.64	72.0	73.0	70.5	.....	1.7	1.05	65	57	0.212	601	632	—31	4.9	.....
9.45	70.80	89.95	71.30	91.39	19.15	20.09	90.8	6.65	72.0	73.0	70.5	.....	1.7	1.05	..	..	0.210	607	636	—29	4.6	0.634
10.00	70.85	90.00	71.40	91.42	19.15	20.02	90.4	6.65	72.0	73.0	70.5	29.48	1.7	1.05	64	55	0.211	605	632	—27	4.3	.....
10.15	70.90	90.05	71.45	91.44	19.15	19.99	90.4	6.65	72.0	73.5	71.0	.....	1.7	1.05	..	..	0.211	605	631	—26	4.1	0.632
10.30	70.90	90.05	71.49	91.34	19.15	19.85	90.4	6.65	72.0	73.5	71.0	.....	1.7	1.05	63	58	0.211	605	627	—22	3.5	.....
10.45	71.00	90.10	71.50	91.21	19.10	19.70	90.8	6.66	72.0	73.5	71.0	.....	1.7	1.05	..	..	0.210	606	626	—20	3.2	.....
11.00	70.95	90.00	71.50	91.16	19.05	19.66	90.8	6.67	72.0	73.5	71.5	29.47	1.7	1.05	62	54	0.210	606	625‡	—19	3,0	0.629
11.15	71.05	90.05	71.50	91.22	19.00	19.72	91.0	6.67	72.0	73.5	71.5	.....	1.7	1.05	..	..	0.210	606	629	—23	3.7	.....
11.30	71.05	90.05	71.50	91.14	19.00	19.64	90.6	6.66	72.0	73.5	71.5	.....	1.7	1.05	62	54	0.211	602	622	—20	3.2	.....
11.45	71.05	90.00	71.50	91.02	18.95	19.52	90.8	6.68	72.0	73.5	72.0	.....	1.7	1.05	..	..	0.210	603	622	—19	3.1	.....
12.00	71.05	89.95	71.47	90.99	18.90	19.52	90.8	6.67	72.0	73.5	72.0	29.47	1.7	1.05	60	49	0.210	601	621	—20	3.2	0.628
12.15	71.10	89.90	71.44	90.92	18.80	19.48	90.6	6.67	72.0	73.5	72.0	.....	1.7	1.05	..	..	0.211	597	618	—21	3.4	.....
12.00	71.10	89.90	71.45	90.84	18.80	19.39	90.8	6.68	72.0	73.5	72.0	.....	1.7	1.05	59	50	0.210	599	618	—19	3.1	.....
12.45	71.10	89.85	71.44	90.84	18.75	19.40	90.8	6.69	72.5	73.5	72.0	.....	1.7	1.05	..	..	0.210	599	620	—21	3.4	.....
1.00	71.10	89.85	71.43	90.82	18.75	19.39	90.8	6.69	72.5	73.5	72.0	29.47	1.7	1.05	59	52	0.210	598	619	—21	3.4	0.627
1.15	71.10	89.80	71.42	90.77	18.70	19.35	90.6	6.69	72.5	73.5	72.0	.....	1.7	1.05	..	..	0.211	596	617	—21	3.4	.....
1.30	71.10	89.80	71.47	90.79	18.70	19.32	90.8	6.68	72.5	73.5	72.0	.....	1.7	1.05	59	50	0.210	596	616	—20	3.2	.....
1.45	71.10	89.75	71.49	90.80	18.65	19.31	90.4	6.69	72.5	73.5	72.0	.....	1.7	1.05	..	..	0.211	593	614	—21	3-4	.....
2.00	71.10	89.60	71.50	90.77	18.50	19.27	90.6	6.70	72.5	73.5	72.0	29.47	1.7	1.05	..	..	0.211	590	615§	—25	4.1	0.626

*Stem correction has been applied to these, and each is the average of five readings.
†Sargent calorimeter gave 616.
‡Sargent calorimeter gave 611.
§B. T. U. in Comdensation, 45,4.

during the day, the points have been joined by dotted lines. The results with the Sargent calorimeter were not placed on this chart for three reasons: First, there were so few of them that it would not have left a fair impression; second, the recording calorimeter itself, when operated by hand is fully as reliable a standard as the Sargent; and third, enough of the Sargent results appear in a table to answer all purposes.

Fig. 2 shows the variations in water and gas rates for a period of 2 days. It took us a number of days to locate the trouble with the gas rate, and after this was accomplished there was such a sameness in the results that it was thought better to plot only two days' figures, which are typical of the best we have been able to secure.

The table summarizes one complete day's tests, and from this the general plan of the work, its thoroughness and the results obtained can be seen.

Taking up the 3 factors required for accuracy, let us first consider the water rate. Fig. 2 shows that during a period of over 6 hours the maximum variation was less than 1.4 per cent., while if the first hour is excluded, the maximum variation is about 0.6 per cent. When it is considered that an error of one-fifth of a second in switching the water made a difference of approximately 0.01 pound in the 2-minute run, it is evident that a maximum variation of 0.04 pound in 6 hours is not in any way excessive. To secure this degree of accuracy, it was necessary to switch the water as the second hand passed the zero mark on the watch, and not to try to start the watch and the water at the same instant. It also became apparent that the water rate must be determined at the beginning of each test, since after removing the air from the water passages, it would be impossible to reset the cock in exactly its original location.

In studying the curves for the gas rate, omitting the first hour, the maximum variation during 6 hours was 0.001 feet or 0.5 per cent. Inasmuch as the smallest division on the dial of the meter represents 0.001 cubic feet, it is evident that the above result is about as nearly correct as accuracy of observation will permit. Practically the only factor whose influence on the gas rate has not been controlled is the specific gravity of the gas, and if this varies greatly during a test, it may be necessary to check the gas rate more frequently. This would be especially true in the case of a mixed gas where the percentages of the coal and water gas might vary. In the case of straight coal gas or carbureted water gas, the errors in any one day due to changes in specific gravity would probably be within the limits of error of the process.

Turning now to the chart of observed B. T. U., which in reality is a test of the accuracy of the recording thermometers and mechanism, it should be remembered that the true test of the satisfactory operation of the recording device lies in the uniformity of variation between the two lines on any one day. The reason for this is that the exit recording pen must be set each morning to agree with the reading of the exit water glass thermometer during a regular test. If this had been done in the tests shown on the chart, it will be seen that a very satisfactory uniformity in the 2 curves would have prevailed. The adjustment of the pen is made by turning a thumb screw, so that no time is wasted in this operation. The chart furnished for our experiments was graduated from 55° to 125° F., and a space of about 0.1 inch represented 1°. It was thus not possible to read the chart closer than 0.1°., and as this equals from 3 to 4 B. T. U., it affected materially the showing on the chart of observed B. T. U. In the chart which will be furnished with the instrument this error will be reduced 50 per cent.

The humidity in the table of sample day's tests was taken by a hygrodeik and a sling-psychrometer. The former was continually ventilated duting tests by a slow current of air from an electric fan, and the latter was whirled and read in the usual manner. Distilled water was used on both instruments, and all calculations made from the same table, although the chart on the hygrodeik checked almost exactly with the table used. The thermometers on the two instruments were compared and found to agree. We call attention to the humidity results as a matter of interest to those making humidity determinations, but no correction based on these results was made. Since the burner and air supply were identical in the tests with the glass thermometers and recording thermometers, and since these tests were made at exactly the same time. the effect of humidity must have been exactly equal in both cases and so need not be considered. Likewise we made one or two determinations of B. T. U. in condensation, simply for the purpose of presenting a sheet of tests complete in all details. The tests with the Sargent calorimeter were necessarily made at somewhat different times from the nearest corresponding tests on the recording instrument, and serve principally to show the absence of any great error in either manipulation or apparatus.

The results of the investigation may be summarized as follows:

1. The instrument should be allowed to run for an hour before tests are made.
2. Water rate must be determined each morning, and should then remain constant within 0.6 per cent.
3. Gas rate must be determined each morning, and should then remain constant within 0.5 per cent.
4. Recording thermometers must be set each morning to agree with glass thermometers, and temperature interval should then remain correct within 1 per cent.

As a result of the experience gained, we suggest the following changes in the instrument:

1. The chart should be graduated vertically in 5-minute intervals, and horrizontally from 550 to 650 B. T. U., in such a manner as to make it a direct reading chart.
2. Arrangements should be made for a more easy insertion and removal of the chart roll, and for care of the chart roll as it unrolls.

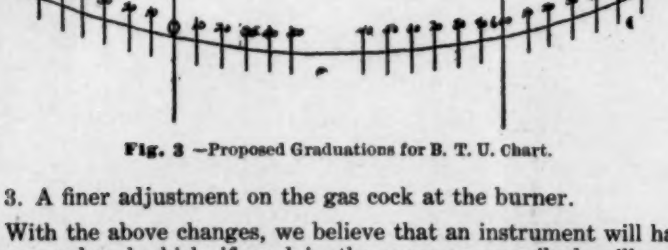

Fig. 3 —Proposed Graduations for B. T. U. Chart.

3. A finer adjustment on the gas cock at the burner.

With the above changes, we believe that an instrument will have been produced which, if used in the manner prescribed, will mark a distinct advance in the field of calorimetric work.

Artificial Daylight—Its Production and Use.[1]

By M. Luckiesh and F. E. Cady.

Artificial illuminants differ in spectral character, and are in general very different from daylight in this respect. However, the importance of the spectral character or quality of an illuminant is not generally recognized, although it is strikingly exemplified by the appearance of colored objects when illuminated by various illuminants. Modern artificial illuminants having continuous spectra, while differing considerably from each other, are all in the same class compared with daylight; except the Moore carbon dioxide tube, which is a close approximation to average daylight. This illuminant has not a strictly continuous spectrum, but for practical purposes it is a very satisfactory substitute for daylight, although its low efficiency prevents its adoption for general lighting.

Daylight is the accepted illuminant for many purposes, and there is a need for artificial daylight in order that certain activities may be continuad after nightfall, or in places where daylight cannot be obtained in sufficient quantity. The trend in the development of illuminants has been toward daylight quality, but notwithstanding the great progress made there is yet no artificial illuminant approximating daylight in color value, that can be used for general lighting. Lacking such, a natural step is to alter a continuous spectrum illuminant by means of colored screens, so that the resultant light approximates daylight sufficiently closely for the intended purpose. Another obvious precedure is to add two or more illuminants of such character as to give a resultant daylight. As early as 1901 Dufton and Gardner made and described a colored glass for use with an arc lamp, which gave a resultant light approximating daylight closely enough to be adopted in the textile mills in England. In recent years other units, more or less satisfactory, have been developed.

In imitating daylight quality it is necessary, first, to determine just what kind of daylight is suitable for the purpose in mind. Daylight varies tremendously with time and place. Sunlight undergoes many changes throughout the day from the white at noonday to the reddish sunset. Blue sky light is very different from sunlight, and while less variable in character and much bluer than sunlight, it is by no means constant. Overcast skies, bright clouds and immediate surroundings alter the light which finds its way into buildings. Ives, in collecting data of Koettgen, Koenig, Vogel and his own, showed that sunlight approximates in spectral character the light from a black body at 5,000° C. He has also plotted data on measurements of the spectral character of blue skylight, and draws a mean curve establishing an average blue skylight. Later considerations indicate the apparent black body temperature of the sun to be in the neighborhood of 5,500° to 6,000° C. Some years ago Ives and Luckiesh produced a colored screen of two glasses and and an analine dye, which altered the light from a tungsten lamp operating at 1.25 watts per candle (7.9 lumens per watt) to clear noon sunlight quality. Of course this was accomplished at the expense of great absorption. Later a glass was made which took the place of the two glasses, but a dyed gelatine film was still required. With the advent of the new gas-filled tungsten lamps operating as high as 22 lumens per watt, changes have been made under the direction of one of the authors, with the result that the screen is now wholly of glass, and has been produced in various forms, so that different kinds of daylight are now obtainable.

The Subtractive Method—Ideal Screens.—An illuminant to be used in an artificial daylight unit must have a continuous spectrum, or one practically so; and of course it should be as near to daylight as possible to begin with. By the subtractive method daylight quality is obtained by absorbing those rays present in greater proportion than found in daylight. This method is wasteful of light, and, therefore, an illuminant for which the necessary absorption is small, is to be desired. The spectral energy distribution is of prime importance, and must be accurately determined. By the method under consideration, rays present in excessive amounts are absorbed by the colored screen, so that the rays transmitted are present in the same proportions as in sunlight or skylight, whichever is to be imitated. In all available artificial illuminants the red, yellow, and orange rays exceed that in sunlight or skylight. It is, therefore, first necessary to choose a point in the extreme beyond which the light will have little practical importance, and from this point to alter the light so that it has the required spectral distribution. The choice of this point is arbitrary and determined largely by experience. The shorter the wave-length of this starting point the greater must be the absorption for the longer wave-lengths. Wave-length 0.42 μ will meet the most exact requirements, and for only rough approximations of daylight, 0.45 μ is a satisfactory starting point. An ideal absorbing screen is one that has a transmission of 100 per cent. at the extreme short wave-length chosen, and that reduces the intensities of the rays of longer wave-length just enough to produce a resultant distribution of energy similar to that in the daylight to be matched. The screen will, of course, differ for various illuminants.

Daylight Efficiency.—All visible rays being present in the radiation from a tungsten lamp it is evident that it has a certain daylight efficiency. That is the radiation can be considered to consist of light of the same quality as sunlight (or skylight) upon which has been superposed a yellow light, with the result that the total light is of an unsaturated yellow color. The ratio of the value of the sunlight (or skylight) component to the total light represents the sunlight (or skylight) efficiency of the illuminant. It is obvious that the daylight efficiency of the incandescent tungsten lamp increases rapidly with the filament temperature.

Additive Method.—Another method of producing artificial light is by the addition of two or more lights of proper spectral character. If two lights are used they may be said to be complementary to each other. It is found that on adding the light from a mercury-vapor arc to that of the incandescent tungsten lamp in proper proportion a white light is obtained. The resultant light, while satisfactory for many purposes, is not an accurate reproduction of daylight because of the gaps in the spectrum of the mercury-vapor light. Another example of the additive method is in the use of the fluorescent reflector with the mercury-vapor lamp. This reflector by its property of fluorescence adds red rays, greatly improving the quality of the light. One of the authors has developed a scheme of coating the interior of an opaque reflector, having a proper surface, with a permanent transparent coloring which adds to ordinary tungsten light some blue and blue-green rays, thus improving the light in its approach to daylight. This method is employed with prismatic reflectors by using coatings convertible into glass, greatly improving the light. These are examples of the additive method, but, with the exception of the first case, the subtractive method is primarily involved.

Actual Production of Artificial Daylight.—After computing the ideal absorbing screen for producing daylight of a certain character the next step is to make this screen a reality.

Let the problem of developing a color screen which will produce artificial blue skylight when used with a new high efficiency tungsten lamp operating at 22 lumens per watt be considered first. A practical solution of the problem will result in a light fulfilling the requirements of an actual color-lighting unit suitable for many purposes for which skylight is used. Modifications of this unit will result in artificial daylight of various qualities. After determining the spectral energy distribution of the incandescent tungsten light, the ideal absorbing screen which will properly alter this light to skylight quality is computed. The problem now resolves itself into producing a glass whicb closely approximates this screen. Obviously it will appear of a blue-green color when viewed by transmitted daylight. Those experienced in practical color science can readily select glasses which show promise. The method is then largely, "cut and try." A favorite method has been to select glass which nearly fulfils the requirements and finally correct it by means of a dye in gelatine. So many dyes are available that there is no difficulty in finding one that will add the final touches. Dyed gelatine is unsatisfactory for commercial purposes, for it lacks the durability of glass, and most dyes fade rapidly under heat. After making up an experimental glass it is desirable to have various thicknesses, for some one density will best answer the purpose. Samples can be ground to various thicknesses and polished, or a wedge can be made. A method involving fewer measurements,

1 From a paper read at the Eighth Convention, Illuminating Engineering Society.

which appears to be sufficiently exact, is to determine the transmission for various wave-lengths at one thickness or density. On a numerical abscissae scale plot thickness, and on a logarithmic ordinate scale, plot transmission values. If the spectrophotometric measurements are made in such a manner that the reflection from the glass surfaces is eliminated, this plot will give a series of practically straight lines meeting at the point represented by 100 per cent. transmission for zero thickness. Hence, instead of making spectrophotometric analyses for a number of thicknesses, only one need be studied.

Commercial Units and their Uses.—Luminous efficiency in artificial daylight production is a minor matter in a unit developed for accurate color-matching, but there are many cases where light approximating daylight is desired for general lighting. Here the wattage is an important consideration, although illuminating engineers and consumers alike must learn that the efficiency of a lighting unit or installation is measured by how well it fulfills its purpose. This means a broader concept than watts per square foot or effective lumens per watt. If a light source is used for illuminating dress goods, and blues cannot be distinguished from blacks, and greens as seen in daylight are confused with yellow and brown fabrics under the artificial light, then the efficiency of the lighting unit or installation falls close to zero in these particular cases. As illuminating procedure becomes more refined and as the efficiency of light production increases, more attention is being given to the importance of quality of light. For these reasons glassware for use with tungsten lamps of high efficiency has been developed which will greatly improve the quality of the light, and do so without such excessive loss of light as to make it impracticable for general lighting.

In this development three phases of daylight have been considered, and three classes of units designed. The latest unit accurately imitating a deep blue north skylight when the highest efficiency tugsten lamp (22 lumens per watt) is used, produces light of a deep blue skylight quality at about 2.9 lumens per watt. With the multiple lamps of the same type the light corresponds to that of skylight not quite as blue, and the luminous efficiency is about 2 lumens per watt. This unit is intended for the purpose of accurate discrimination of color in textile mills, laboratories, color-printing shops, etc. The colored screen is entirely of glass and as there is no excessive temperature rise in a well ventilated unit the glass is permanent, and the unit entirely safe.

The next class of units is intended to imitate clear noon sunlight, an average outdoor daylight. Very often indoors the daylight quality is a mixture of sunlight and skylight. This unit produces a satisfactory artificial sunlight for many purposes at an efficiency of about 7 lumens per watt with multiple tungsten lamps operating at an efficiency of about 16.5 lumens per watt, an efficiency for artificial sunlight practically the same as the luminous efficiency of the older type of tungsten lamps. This makes sunlight quality available for general lighting purposes in color factories, lithographing plants, wallpaper and paint stores, paint shops, cigar factories, art galleries, etc.

Other units have been made by combining this colored element with ornamental glassware by casing with light-density opal or by mixing intended for use in general store lighting where a better quality of light is desirable than can be obtained from any light source available for general store lighting.

It is futile to attempt to give absorption data on these units because of the variety of densities of the coloring element which can be incorporated in different kinds of white or opal glass. It must be remembered that the quality of the light is somewhere between the original tungsten light and sunlight. The new lamps not only operate at a much higher efficiency than those of the older type, but their light is much nearer to daylight. This means a higher efficiency and a whiter light to begin with, thus giving the new tungsten lamps a dual advantage over the older type.

Other Commercial Means of Imitating Daylight.—As already stated, any light having a continuous spectrum, or one nearly so, can be used for making artificial daylight. Other desirable characteristics are steadiness both as to quality and intensity, and high luminous efficiency. The electric arc early entered the field and has been used considerably, although the fluctuations in the color and intensity are serious drawbacks. No better approximation of average daylight could be desired than the beautiful white light of the Moore carbon dioxide vacuum tube lamp. The luminous efficiency of the small units are quite low, however, and other difficulties have prevented the general adoption of the longer tube, although wherever this unit has been used the quality of the light appears to be satisfactory. In 1909 the mercury-arc lamp was combined with the tungsten lamp in proper proportion giving a white light, only an approximate imitation of daylight, the blue lines of the mercury spectrum supplying the blue rays in which the old tungsten lamp was deficient. The addition of the fluorescent reflector to the mercury-vapor lamp greatly improved this illuminant by adding red rays largely at the expense of green light.

Early in 1911 Ives and Luckiesh, by means of two commercial glasses and an analine dye, produced a screen for use with the old tungsten lamp operating at 1.25 watts-per-candle for the purpose of producing "average daylight," noon-day sunlight.

In 1912 R. B. Hussey described a screen for use with an intensified arc, using pieces from two colored glasses arranged in a checker-board fashion with suitable diffusing glasses to mix the light. This daylight arc is a near approach to daylight, as far as colorimeter measurements can be trusted, although it shows an excessive greenish component that could be easily remedied.

Sharp and Millar produced a daylight effect by means of colored screens and tungsten lamps. About this time several other units designed to produce artificial daylight appeared, but no examination of these has been made by the authors and no quantitative data are to be found regarding them.

One of the authors has successfully used colored lamps combined with clear tungsten lamps by the additive method; blue, green, and blue-green lamps being used. A notable installation was the lighting of the paintings of the Cleveland Art Loan Exposition, perhaps the first large exhibition of paintings where any attempt has been made to produce a daylight appearance.

Besides the glassware already described, metal reflectors have been developed having a tinted surface of a character that alters the reflected light to a color complementary to the direct light from the tungsten lamp. This results in altering the distribution curve of the reflector, producing in general less concentrated distribution; indicating that focussing and intensive reflectors should be used instead of extensive. With tinted reflectors of a deep tint, a very good quality of light is obtained at a loss of about 50 per cent. of the original useful light. With coatings of less color the loss of light is less, but the improvement in color is likewise less. No attempt has been made to reproduce skylight, or even sunlight, but a very desirable increase in blue and blue-green rays has been obtained. Another instance of the use of the colored lamps is in a large residence in Cleveland, where red, green and blue lamps have been combined above diffusing glass in the dining room ceiling to produce various effects, one being an approximate daylight.

In 1913 Ives adapted a colored screen to the Welsbach gas lamp for producing artificial daylight, which is used commercially.

Interest in the color-value of light is increasing and will continue to grow, for it is of great importance in lighting problems. It is possible to obtain glassware of a proper tint to suit nearly all requirements on the scientific side up to the accurate discrimination of colors; and on the artistic side toned glassware is obtainable in many tints. These can be supplemented by endless possibilities in silks, or glass shades and reflectors, and by controlling the color of surroundings. More attention must be paid to the effect of colored surroundings in altering the color of the useful light, for it is wasteful to produce a satisfactory daylight quality and waste it on yellow walls and ceilings. It is possible to produce light of daylight quality by indirectly lighting a room with wall coverings of proper color.

This paper is by no means a complete treatise of this subject. An attempt has been made to cover both the theoretical and practical production of artificial daylight, and to indicate briefly the development of this phase of lighting procedure. Some units have been examined which have not been included in this paper, because they were found to be practically worthless.

Discussion.—Mr. R. F. Pierce: I do not wish to discuss the technical portion of the paper, but inasmuch as particular reference has been made to the commercial application of the devices, I think it is necessary to call attention to the fact that some of the terms are used in a sense in which they cannot be used with any degree of satisfaction in commercial work. For instance, reference is made to skylight and daylight in the sense of standards, which they are not and cannot nossibly be. They vary so widely that any attempt to use them as standards is bound to lead to commercial difficulties. This particularly holds with reference to the device described as available for accurate color-matching in textile mills. If a device of this character were put in a dye works and the dyer told that it gave an accurate reproduction of north skylight, the first thing he would do would be to compare it with the north skylight available, and the chances are about 100 to 1 that he would not obtain the same color comparison under the two conditions; because the chances of obtaining average north skylight, an arbitrary

(*Continued on page 394.*)

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NEW YORK, MONDAY, DECEMBER 21, 1914.

Good Times.

The prediction of good times is always an asset on the side of constructive work, and this alone can make times good in such a trying period of the world's history. In spite of the destructive conflict which is ranging in Europe, in many directions business conditions are better than they were a year ago, as we have a partial clearing after the storm rather than the mugginess of inactivity. Leaving the South's cotton situation, and the Wall Street position out of consideration for the moment, we find that with some readjustments our total volume of business can be brought up to what we have considered a good volume. The principal readjustment must be in our import business rather than in the export. The possibilities in the latter are restricted by the inability to sell goods to Germany, Austria and Belgium, due to the war; and to South American countries because of lack of capital. Our imports continue to increase, however, and as long as this continues it means that we will be a debtor instead of a creditor nation. Under such condition we will not be in a position to expand our export business to South America and other countries on a credit basis, and this is the basis on which we must expect to sell goods, as they already owe more money to Europe than they can pay.

"Made in America," is a commandment to do constructive work, rather than a meaningless though patriotic by-word. When good times come, and they are approaching nearer that ideal each day, we will be converting our own cotton in our own factories; we will be utilizing the by-products of our gas industry; we will be making countless things which we now import. The business of utilities is effected the least of any industry by the war; they will not have large increases from orders for war materials, now will they experience a decrease in revenues, owing to the fact that their products are necessities and used in so many different ways. Their greatest ultimate benefit will come from an active participation in the work of making "Made in America" mean something forceful.

High Court Rules on Franchise Value.

The New Jersey Court of Errors has reversed the decision of the State Supreme Court upholding the ruling of the Board of Utility Commissioners reducing the price of gas in the Passaic Division from $1 to 90 cents. In January, 1912, on petition of the city of Passaic, the Commission ordered a reduction in the gas rate from $1 to 90 cents in the Passaic district, and in recommending a similar reduction in the rest of the territory of the Public Service Gas Company, insisted that no value for special franchises should be considered, claiming that it was possible for the company to receive a fair return on its investment even with the reduction.

An appeal was taken by the company to the Supreme Court and the decission of the Commission was upheld there. The case was then carried to the final court, and the Public Service was the victor there, that body refusing to sustain the Supreme Court.

The only substantial difference between the Supreme Court and the Court of Errors was on the question of the valuation of the franchises. It agreed that 8 per cent. was a fair net return to allow the company upon the true value of its property.

"It seems a fallacy to say," Justice Parker says in his decision, "that if and because a municipality confers upon a gas company or a street railway company the privilege of using the public streets without any consideration in cash or property passing from the company, the rights thereby conferred should have no value for rate-making purposes; for this disregards at least the meritorious consideration that the promoters of the company have invested their money and given their time and taken business risks in view of the making of this concession; and the value of the enterprise on which the owners are entitled to draw an income should not be limited to the mere cash they have put into it, but should include something for the risk and responsibility taken in organizating and developing it."

"It is true," Justice Parker continues, "that the utilites act forbids the capitalization of franchises. This prohibition, however, refers to the inclusion of a franchise valuation in the par value of capital stock, but does not affect its market value."

In disposing of the contention that secondary franchises are contributed by the public and therefore should not figure as a basis for rate-making, Justice Parker says: "Recurring to the argument that these special or municipal franchises are given to the utility or contributed by the public, and therefore should not be estimated in fixing a rate, we repeat that the minor premise is an unwarranted assumption of fact."

Following a discussion of the method of forming a utility corporation and the risks taken by those who invest in them, Justice Parker says: "All such franchises are based on a consideration, namely, the risk and obligation undertaken by their grantees, and it will not do to say that the franchise is a public contribution exclusively. If the plant and franchise be taken over by the public the franchise must be paid for like any other property."

Further legal action has already been started. Chancellor Walker, upon request of attorneys representing some 30 towns, has announced that he will reconvene the Court of Errors to-day to hear application for reargument. In granting the request, Chancellor Walker said: "Here is a case that is admittedly of great public importance. The cities of Passaic and Paterson are the plaintiffs in the case, but the result of the decision affects Jersey City, Trenton, Hoboken, East Orange, Camden, Milburn, and the residents of 20 other New Jersey localities.

Empire State Gas and Electric Association.

The first of the mid-year meetings of the Empire State Gas and Electric Association, was held in the Hotel Ten Eyck, Albany, on Dec. 10th and 11th, with between 50 and 60 members present.

President J. C. DeLong called the session to order at 2 P.M. on Thursday. The chief subject for discussion was the handling of bill and service complaints, opened by Mr. C. G. M. Thomas, who outlined the practice of his company. Mr. Thomas took up such questions as testing meters and adjustment of bills on account of fast and defective meters, the method of notifying the customer, and a number of other points related to the subject. A number of others outlined their methods and the general discussion consumed the entire afternoon. At 7 o'clock the members dined together at the hotel, but there was no session in the evening.

The meeting reconvened at 10 A.M. on Friday, when further discussion was started on the complaint question. It had been announced in advance that there would be one session with no specific subject, which would be open for the discussion of any matter the members cared to present. Quite a number of interesting points were brought up in this open session which lasted until 4 o'clock in the afternoon.

A suggestion was made to the Executive Committee that more uniform practice in adjusting bills in the case of wrong meters was

desirable, and that a tentative scheme might be prepared and distributed to the members for their criticism.

During the course of the meeting the Secretary was instructed to send a telegram to Mr. Thomas A. Edison, expressing the regret and sympathy of the Association in the loss and inconvenience occasioned him by the disastrous fire in his plant.

Another subject that received considerable attention was the matter of consumers' deposits, and a plan was proposed of exchanging information on customers who have moved from one town to another. The Executive Committee was asked to take up this question.

I. E. S. Rating of Illuminants.

The Committee on Nomenclature and Standards of the Illuminating Engineering Society has been considering the rating of lamps and illuminants, and at its last meeting adopted the following resolution, which was later approved by the Council of the Society.

"It is the opinion of this Committee:

(1.) That the output of all illuminants should be expressed in lumens.

(2.) That illuminants should be rated upon a lumen basis instead of a candle power basis.

(3.) That the specific output of electric lamps should be stated in lumens per watt; and the specific output of illuminants dependent upon combustion should be stated in lumens per British Thermal Unit per hour."

Mr. Doherty on Conditions.

Mr. Henry L. Doherty is but lately returned from a three weeks' stay in London, and is thus quoted on the subject of business conditions in England:

"I do not believe that anyone can determine the immediate outlook in the investment situation. There is not much doubt that the European buying power is cut down enormously by the war. But the most significant factor I observed is that everybody is assured that, outside of subscriptions to war loans, the investment buying will be in American securities. People who have criticised the American market and serurities and 'Yankee' policies are not talking that way now. The universal feeling is that American securities are the safe securities now."

[Official Notice.]

Wisconsin Gas Association.

Office of the Secretary-Treasurer,
Milwaukee, Wis., Dec. 10, 1914.

To the Members of the Wisconsin Gas Association: Under instructions contained in a resolution adopted at our last annual meeting, your Executive Committee has completed arrangements by which the Annual Convention of the Wisconsin Gas Association will be held jointly with the Wisconsin Electric Association, on January 20th, 21st and 22d, 1915, at the Hotel Pfister, Milwaukee.

The first day of the meeting will be devoted to matters pertaining to gas interests, including the usual order of business provided under our constitution. The second day's session will be held jointly with the Wisconsin Electric Association for the presentation and discussion of subjects of common interest. The banquet will be on the evening of the second day, this also a joint affair.

The third day will be devoted exclusively to the business of the Electric Association.

Papers on appropriate subjects are in the course of preparation, the titles of which, and other details relative to the convention, will be given in a later announcement.

In order to determine the advisability of continuing our annual meetings in conjunction with those of the Electric Association, it is particularly desirable that this meeting be well attended, so that any action which may be taken relative to this subject represent as nearly as possible the unanimous wish of our Association. Remember the new dates—January 20th, 21st and 22d, 1915.

Respectfully, Henry Harman,
Secretary-Treasurer.

Publications.

[All Publications, Catalogues, etc., mentioned below, are kept in our office for the convenience of our patrons.]

Mantles.—The Welsbach Company have issued Catalogue No. 16, covering their line of Gas Company Mantles and some of the Lamps which they manufacture. A leaflet describes their new Reflex-42, which has the same burner construction as the No. 20, but with a much more ornate shell in Flemish finish. The attractive glass reflector used is made especially for this product.

Minnesota Rates.—The rates of Gas, Electric, and Water Utilities in the State of Minnesota have been compiled under the direction of Prof. G. A. Gesell of The University of Minnesota and published by them. It is very complete and the text is explanatory, no attempt being made to draw any conclusions.

Fixtures.—Semi-Indirect Lighting Fixtures are illustrated in leaflet issued by Messrs. Bayley & Sons. The possibilities of a much larger development in gas lighting is apparent from the character of the designs.

Japanese Gas Journal.—The November 15th issue of the "Journal of the Imperial Gas Association of Japan" contains an editorial in English on the effects of the European War on the industry, in which they state that the price of mantles has increased 50 per cent. owing to shortage of thorium. The supply of a number of other articles has been cut off, so the field for American products has at least one outlet. The by-product industry is to be promoted under the auspices of the Association. Gas Institute please note.

Gas News.—The clever little monthly which has been gotten out so successfully for the past few years by Mr. G. W. Allen gives publicity to the Toronto Company's Emergency Service as well as the goods they have for sale.

Rotary Pumps.—"Cycloidial Pumps" is the title of an unusually valuable catalogue on some of the latest models and designs made by the Connersville Blower Company. Their use is especially recommended to gas companies for handling tars and liquors, as well as for ordinary pumping service. Clear-cut technical descriptions are backed up by photographs of typical installations. As a work of the printers' art it ranks very high, and it should be a source of pride as well as of profit to the company.

Purifying Material.—Behrend's Lux Gas Purifying Material has 16 reasons for superiority, according to a leaflet issued by F. Behrend. Buyers of similar material of whatever make will find in this, hints on the desirable qualities of the product, and things which may lead to valuable conclusions.

Bureau of Mines.—The Annual Report of the Director of the Bureau of Mines for the fiscal year ended June 30, 1914, is published as of this date- The work, under the direction of Mr. J. A. Holmes, has come to the attention of our readers in connection with reports of investigations covering "Safety" work in Coal Mining and Coal Analysis, which the report covers in detail.

Ovens.—Equipments for the bakery and hotel kitchen are described in the catalogue (N. C. G. A. style) of the Meek Oven Company. The lines of this company have been extended to cover a number of useful appliances since Sales Manager Vogel became associated with them, and no doubt some of the progress has been due to his efforts.

Safety News.—Constructive ideas on safeguarding our life and health marks the October number of the publication issued from the Claim Department of the United Gas Improvement Company. Mr. Douglas usually does this right and the place he has made for himself is made more important by this publication. Write for a copy. "Be Careful."

Gauges.—Differential recording gauges and gas orifice meters are described and illustrated in "Foxboro Bulletin" 86; and bulletin 91 covers Thermometers and Thermographs.

Paint.—Were it not that the Yuletide is upon us, we might have mistaken holly for laurel on the cover of "Graphite". This attractive little house organ has attained the age of sweet sixteen. If you want to know how far a car will run, write the Jos. Dixon Crucible Company for a copy of "Graphite".

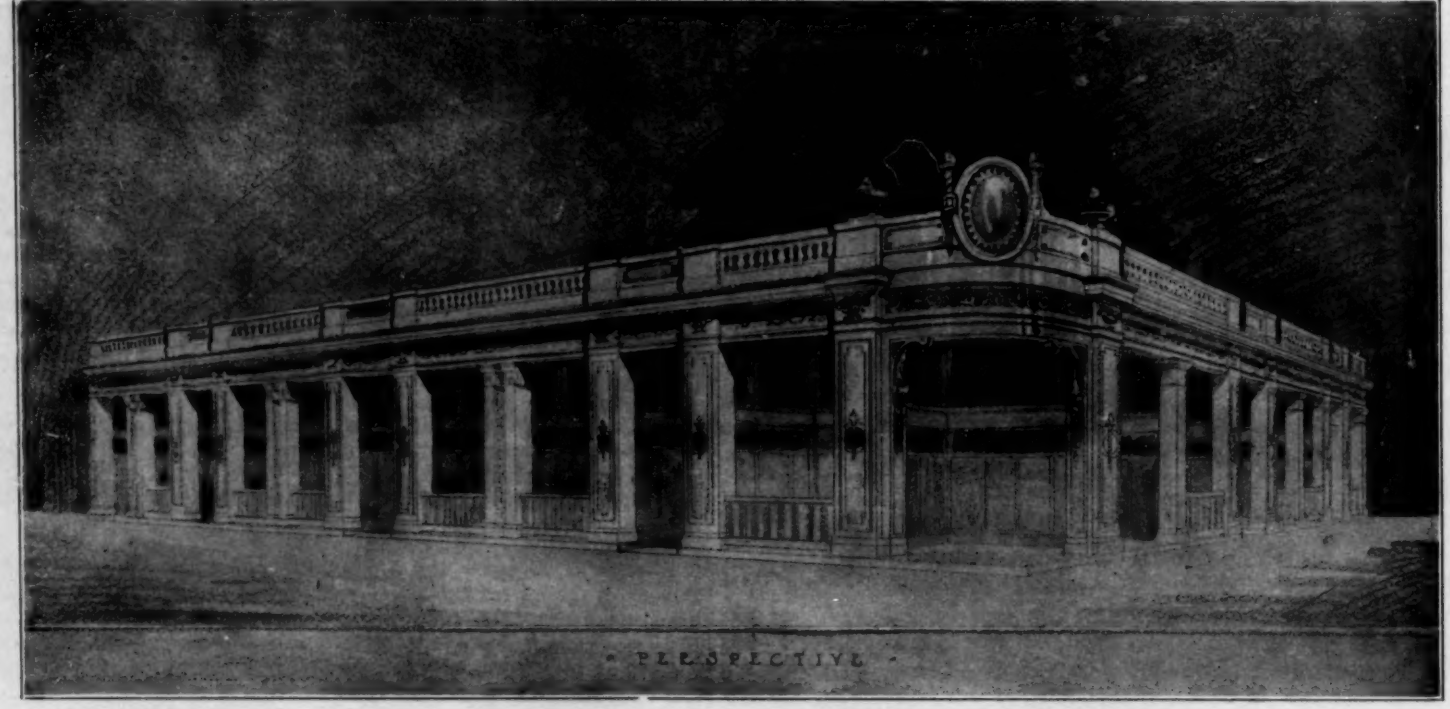
(*Continued from page 391.*)

Artificial Daylight– Its Production and Use.

average selected for the purpose of comparing an apparatus of this sort, are quite remote on any particular day. As far as discrimination of colors is concerned, one light is as good as another. Any light will enable one to discriminate accurately between colors with reference to their appearance under the same quality of light at any other time. so all that is gained by an apparatus of this sort is an approximation to what has previously been regarded in that particular trade as a standard (in the case of a dye works, north skylight). The dyer is aware of the fact that north skylight changes considerably in its characteristics and effects from day to day. It is, of course, legitimate to emphasize to him that in an apparatus of this kind he has a true standard, but one should carefully avoid anything that would lead him to believe that he might make a color match under this apparatus and duplicate the match with the particular north skylight available at any moment. I believe that north skylight has been used by dyers more than anything else on account of its being more readily obtainable over a period of time, and with a greater degree of uniformity than natural light of any other kind. However, the light of the tungsten lamp, the gas lamp, and direct sunlight is of quite as much importance in the preparation of textile materials and in the matching of samples of them as north skylight. The fact that a piece of goods is matched under north skylight does not necessarily establish that it will always be worn under north skylight; and you may make a perfect match under north skylight, or under artificial light that will be anything but a perfect match and display everything but pleasing color characteristics under direct sunlight.

It might be suggested that in exploiting an apparatus of this character it would be well to call the attention of textile manufacturers to the fact that it is desirable to have available means of producing a light of approximately sunlight value as well as north skylight value, and artificial illuminants also: and that goods should be compared and inspected under all three to determine the characteristics they are likely to display when worn. Of course on one side of the street we may obtain approximately north skylight; on the other side of the street, direct sunlight; but it is hardly right to ask the ladies to change their clothes on passing from one side of the street to the other. They could hardly carry a change of clothes in a vanity bag unless they left their pocketbooks at home. In the commercial application of a device of this character, it should always be borne in mind that the term "standard daylight" must be used with the limitation I have stated.

GAS EXHIBIT AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION.



Pavilion in the Palace of Manufacture for Collective Gas Exhibit.

Mr. E. G. Cowdery, Chairman of the Committee on Gas Exhibits, A. G. I., is receiving applications for space in the Gas Pavilion at an encouraging rate, and indications are that the gas men of the country will have there the greatest exhibit of gas making and gas using appliances ever collected. A total of 106 manufacturers have already asked for space.

The classifications under which these exhibits are grouped, is as follows: Group 70—Manufacture, Distribution and Uses of Gas for Light and Fuel.

Class 353. Manufacture of gas; processes and apparatus for manufacturing gas from coal; processes and apparatus for manufacturing water gas; processes and apparatus for manufacturing oil gas; apparatus and materials for the physical and chemical cleansing of gas; apparatus for testing crude materials and manufactured gas.

Class 354. Distribution of gas; pipe, pipe fittings, valves, pressure-regulating apparatus; tools used in laying mains or services; meters and gas measuring apparatus; appliances for the transmission of gas, including exhausters and compressors.

Class 355. Uses of gas; incandescent gas lamps and mantels, gas burners, and appliances for gas lighting; appliances for cooking by gas; appliances for heating by gas, including water heaters and hot air furnaces; appliances for utilizing gas for industrial purposes.

Mr. John B. Redd of the Pacific Gas and Electric Company has been selected as superintendent of the exhibit, and a local committee, consisting of F. A. Cressy, chairman; F. A. Leach, D. E. Keplemann, Paul Haugh, F. C. Millard, C. P. Babcock, R. S. Thompson, B. S. Petersen, H. P. Pitts and H. R. Bashford, has been appointed to work in conjunction with him in preparing for the exhibition.

The A, G. I. Committee on Gas Exhibits is constituted as follows:

E. G. Cowdery, Chairman,	Wm. A. Baehr,
T. D. Miller,	O. O. Thwing,
Paul Doty,	P. N. Guldlin,
J. M. Morehead,	E. C. Jones, *ex-officio*.

Anyone contemplating exhibiting should lose no time in writing to Mr. Cowdery at Chicago, as unreserved space is not plenty, and delay may mean shut-out. This looks like a good follow-up for National Advertising, and the kind of opportunity that comes but seldom.

Gas Manufacture from the Point of View of Physical Chemistry.[1]

By W. F. RITTMAN.

[With permission of the Director of the Bureau of Mines.]

Value of Research Chemistry. Gas Making is Chemical Engineering.

The inertia of past practice, and the refusal to face facts as they exist, are the two most serious obstacles in the progress of industrial art. In past practice, gas manufacture has been primarily an engineering problem, with the chemist a more or less necessary adjunct for the analysis of coal, coke, oxide, etc. The research chemist, who deals with the processes of manufacture and the phenomena of reactions involved, has been looked upon as a burden unwarranted by returns. In view of the present available raw materials for gas manufacture on the one side, and the demands of the public on the other, the advisability of continuing this policy is a serious question. Few industrial operations, from the standpoint of physical chemistry, are more complex than the treatment by heat of coal, oil and water in the production of coke, gas, tar, ammonia and cyanogen. In gas manufacture practically all the variables of chemical phenomena are involved. While this greatly complicates the industrial problems theoretically and practically, at the same time it greatly enlarges their possibilities, and emphasizes the need of continued scientific research and investigation in connection with them. The heat treatment of coal, oil and water necessitates dealing with the chemical reactions of solids, liquids and gases, and with all the laws, both physical and chemical, which governs these reactions. The finest possible equipment, designed with utmost mechanical precision but without regard for the laws which govern the reactions carried out in it, is likely to be less useful than apparatus of the poorest mechanical construction, that does consider the chemical changes involved. Obviously the aim of any industrial operation is perfection both in process and apparatus. Problems primarily chemical, and which can be attacked most efficiently from a chemical point of view, are common in gas manufacture. Who of you have not at some time or another faced problems resulting from naphthalene, drip oil, fluctuating candle power, deposted carbon, ammonia, sulphur, cyanogen, or any one of a dozen other factors? Every new development in gas manufacture will create new problems; every improvement will involve some questions peculiar to it. The greater the number of researches, the greater the progress in any field, and the greater the number of new problems.

Hitherto the greatest progress in American gas manufacture has been along mechanical lines, and as Americans we may be proud of this progress. Chemical development, however, is far behind the mechanical and operating improvements. It may be said that we have been too much investigating the machine, rather than what goes on inside of it. Were the machine the thing of vital importance, improvements would be essential, but the gas factory of the future will earn, or fail to earn its dividends as it turns out, or fails to turn out the best relative yield of coke, gas, tar and ammonia. It is true that the machine and the process are vitally related, but it seems that too many purely theoretical chemical problems have been left to the mechanical engineer for solution. A mechanical, electrical or civil engineer, whose business is the building and operation of machines and equipment, and whose academic study of chemistry and physics were only during a part of two years, should not be expected to be as efficient in chemical research as the man who has devoted himself exclusively to the study of chemical and physical phenomena. To carry out high grade research and investigation in any line, well paid specialists must be employed. The efficient chemist and chemical engineer can do better things than analyze coal and iron oxide.

The day is past when gas making was primarily a mechanical operation. Carburetted water gas constitutes approximately two-thirds of the gas made to-day, and it is no longer possible to buy a high grade paraffin gas oil for 3 cents a gallon. Consequently, the petroleum supply is a most vital and important problem to the American gas manufacturer. Its importance can be conveyed by the fact that in 1913, Greater New York alone used approximately 3,860,000 barrels of oil in the manufacture of carburetted water gas, and approximately 1,600,000 tons of coal. On the basis of heat units oil has become as important as coal. The increasing price of gas oil has created what many gas men regard as a "dangerous" situation; and this despite the fact that never before has so much oil been produced. Why then is gas oil so expensive? Why should hundreds of millions of dollars worth of oil carburetting machinery be threatened? What makes the economical use of petroleum one of the chief problems of the gas manufacturer? It is, first, the scientific progress in petroleum refining; and, second, the changing character in composition of oil from new fields. By careful scientific investigation, the application of physical chemical principles, the refiner has perfected processes whereby the oil which you used to buy at 3 cents a gallon is now converted into gasoline and other end products, that sell at several times that price. An example of this progress can be had from the testimony of F. B. Lewis, Jr., Manager of the Standard Oil Company refinery at Whiting, Ind., at a recent court hearing in Chicago.

"Q. Your Whiting plant is running exclusively on Mid-Continent oil, is it?
"A. Yes, sir.
"Q. Now tell us, Mr. Lewis, what percentage of the crude oil is refined into gasoline?
"A. With the present methods of distillation you can refine it all into gasoline if you wish to.
"Q. The entire percentage?
"A. You can convert it all into gasoline, except what coke is left in the still, and a little wax or petroleum tailings.
"Q. How long has that method been in use?
"A. About one year.
"Q. Is that method in use at the Whiting plant to-day?
"A. Yes, sir.
"Q. To what extent?
"A. To convert the fuel oil that we don't have sale for, into lighter product; fuel and gas oil we have no sale for into motor fuel, which is practically gasoline."

This means that if gas men are to continue the use of petroleum in carburetting water gas, they must resort to one or two alternatives:

1. Greatly increase the yield of gaseous hydrocarbons from gas oil.
2. Perfect methods of using the millions of barrels of fuel oil which are considered unfit for water gas making.

One often hears the statement that these so-called fuel oils cannot be used in carburetting. Is this statement the result of scientific study and investigation, or of experiments under the same old conditions which prevail in the use of Pennsylvania, Ohio or Indiana petroleum?

My purpose in emphasizing the gravity of the petroleum situation in connection with gas manufacture, is not to destroy hope nor to disseminate pessimism. On the contrary, I believe that as soon as the gas manufacturer faces the facts and seriously attacks the problem, increased efficiency and economy will result. Never in the history of the world has so much oil been produced as is being produced to-day. It is estimated that Oklahoma alone will mine 80,000,000 barrels. California will contribute another 100,000,000 barrels. Never has there been as much oil in storage as to-day. We are not facing an oil famine. We are facing a famine of knowledge concerning the chemical behavior of inferior petroleums which will facilitate their substitution for higher grade oils.

If we accept the statement that these fuel oils cannot be used to carburet water gas, the necessity for scientific chemical research becomes more acute than ever. It means that curburetted water gas is doomed, and is to be replaced by coal gas, by-product coke oven gas, or some other process gas not yet developed. The problems involving physical chemistry will not be eliminated. The phenomena of chemical change are involved in any process wherein a solid or liquid is converted into a gas of different constitution.

The machine becomes of vital importance when it favors or hinders optimum conditions for the end products desired. Aside from operating costs, the relative merits of horizontal *vs.* inclined *vs.* vertical retorts depend entirely upon the influences of the retort's position on physical and chemical changes. The relative merits of any structure used in gas manufacture depend upon its influence on the chemical reactions which produce the ultimate end products. The vertical retort completely filled, yields more tar and less gas than the practice of partially filling the vertical retort, simply because the vapors are subjected to different physical conditions which influence the degree of cracking and tend to bring about equilibria concordant therewith. This difference in end products, using the same type of machine, indicates the complexity of the chemical reactions of gas manufacture, and the close relations between conditions and end products. Both coke oven gas and retort gas are made by the application of heat to coal, yet the two gases differ considerably in composition. Therefore, should we not look for a better understanding of the composition of the raw materials, and the changes and mechanism of the changes under different physical conditions?

1. Written for New York Meeting, A. G. I.

When pointing out the seriousness and the dimensions of the gas man's chemical problems, and referring to the eflorts and accomplishments of petroleum refiners, it would be unjust to overlook the research work started within the last 3 to 5 years. However, practically all of these investigations deal with coal. They are concerned with determining;

1. The composition of coal.
2. The initial decomposition products.
3. The final decomposition products under varying temperatures and pressures.
4. The nature of the tars produced under varying temperatures and pressures.

Much of this work may appear too academic; but our industry progresses as the result of just such investigations. Regardless of whether a low temperature process, for example, is valuable for direct application, the information obtained on the constitution and chemical behavior of the coal, is of utmost importance. The information with respect to petroleum is equally essential. As a matter of fact, prior to the works above referred to, the extent of change that takes place in the destructive distillation of coal was a question. In other words, do the end products occur in coal as such, or are they formed in the operation? Does benzene occur in coal as benzene, or is it formed in the distillation? Today these questions appear unnecessary. We believe that benzene does not occur perceptibly in the original coal, nor in appreciable quantities in Eastern gas oils. The fact that it is found in both water gas and coal gas tars indicates that it is made in the course of the gas-making process by a transformation—a chemical change. That this change is not a simple one can be seen from the investigations referred to. Further, it is found that when coal is distilled under a vacuum, very little benzene is formed. When the mechanism of its formation is understood, it will be relatively simple to increase or decrease the yield. Benzene is referred to only as an illustration. The same reasoning applies to tar, ammonia, and cyanogen formation in gas manufacture. If naphthalene is an undesirable product its appearance is not proof that its production cannot be avoided.

The variation in the tars from different processes of coal, oil and coke oven gases, is due to variations in the physical conditions. The initial materials used in the processes may be the same. With the reason for these differences fully understood, the optimum conditions for manufacture of both tar and gas will be understood. The tars from the destructive distillation of oil under different physical conditions, vary as widely as the physical conditions under which they are made. In the course of a research carried out by Prof. M. C. Whitaker and the writer on the destructive distillation of petroleum, it was found that the tar made under diminished pressure was radically different from that obtained by cracking the same oil under atmospheric or greater pressure. The vacuum tar was of much lighter specific gravity; contained practically no free carbon; no naphthalene or anthracene settled out of the heavier distillates of the tar; the tar combined readily with 1.82 specific gravity sulphuric acid. Tars resulting from cracking the same oil under pressure contained much free carbon; were of considerably higher specific gravity; naphthalene and anthracene settled out of the distillates; they contained benzene; and would not combine readily with 1.82 specific gravity sulphuric acid. The gas made under the two conditions was of equally different composition. The vacuum gas was a "dry" gas, in that it contained practically no benzene, but it was high in ethylene homologues. The volume of uncombined hydrogen under vacuum conditions was very much less than when the machine was under increased pressure. Further, there was practically no deposit of free carbon when working under a vacuum, whereas when the pressure on the machine was increased to 3 atmospheres, over 50 per cent., by weight, of the original oil was deposited as carbon.

Let us see how far the 5 variables common to any gaseous chemical reaction have been investigated with respect to illuminating gas:

1. Temperature.
2. Pressure.
3. Concentration (Mass action).
4. Duration (Time).
5. Contact Surface.

On the basis of combinations and permutations, it is evident that a great variety of manufacturing conditions can be had. Opinions differ as to when a field has been properly and sufficiently investigated, and I, therefore, do not pretend to determine what proportion of the work remains to be done. Each individual must form his own opinion. The field of temperature has been widely investigated, but principally with the machine under atmospheric pressure. Experiment shows that the moment we change the pressure, new results are obtained, and a new series of experiments are suggested. Certain it is that much remains to be done in the field of concentration, pressure and contact surface changes, and the application of various conditions for different periods of time still need investigation.

I repeat that even if such investigations do not result in radically new processes, they will yield valuable information for a better understanding of, and improvement in present day practice. From a practical viewpoint, we may not yet see the advantages of the application of such scientific investigations, and perhaps we may see disadvantages. However, this should not prevent our exploring the field. Industrial experience has again and again proven that the theory of to-day is the practice of to-morrow. Without theoretical considerations, applied chemistry to-day would be in the mediaeval stages. As a typical example, the investigations of Haber concerning the manufacture of ammonia from hydrogen and nitro- were on a purely theoretical basis. From an initial yield of less than ¼ per cent., the process has been made to give a yield of well over 10 per cent. of ammonia.

From the ideas of a man whose principle tools were theoretical chemistry, mathematics and physics, laboratory experiments developed a process commercially important. The same laws obtain in the ammonia production of the gas plant as in Haber's apparatus. The combination of nitrogen and carbon in the formation of cyanogen compounds is influenced by physical and chemical conditions, just as surely as is the production of ammonia, whether from coal distillation or direct from the elements as in the Haber process.

The application of physical chemistry to industrial problems in mathematical terms, furnishes a means for quantitatively expressing yields and reactions taking place. I refer to the equilibrium relationship. Under some conditions, it is highly important that the system reaches a state of chemical equilibrium; under another condition it would be fatal for the system to reach such an equilibrium. Let us consider a few typical examples:

No.	Reactions.	Heats of Reaction.	Volume Changes.
1	$C+2H_2=CH_2$	+18900	2 to 1
2	$2C+H_2=C_2H_2$	−58100	1 to 1
2	$3C_2H_2=C_6H_6$	+163000	3 to 1
3	$C+H_2O=CO\times H_2$	−29300	1 to 2
5	$CH_4+H_2O=CO\times 3H_2$	−48200	2 to 4
6	$CO_2+C=2CO$	−36950	1 to 2

No.	Partial Pressures	Approximate. K_{600}	Approximate. K_{900}
1	$K=\frac{CH_4}{(H_2)^2}$	0.077	0.003
2	$K=\frac{C_2H_2}{H_2}$	1.1×10^{-13}	5.7×10^{-10}
3	$K=\frac{C_6H_6}{(C_2H_2)^3}$	9×10^{23}	1.2×10^{18}
4	$K=\frac{CO+H_2}{H_2O}$	0.2	25.0
5	$K=\frac{CO+(H_2)^3}{CH_4+H_2O}$	0.06	346.0
6	$K=\frac{(CO)^2}{CO_2}$	0.1	59.0

It is evident that for some reactions a high temperature favors the preservation and formation of hydrocarbons; whereas, for other reactions, the same temperature is destructive. Considering equations (4) and (5), two of the most vital in carbureted water gas manufacture, one finds that a temperature of 900° C is favorable to the CO and H_2 formation of both (4) and (5); but is unfavorable to methane preservation of (5). On the other hand, a temperature of 600° C is unfavorable to the formation and preservation of CO and H_2; but is decidedly more favorable than 900° to hydrocarbon preservation of (5). At this lower temperature, however, the CO_2 of (6) predominates. From reaction (1), it is evident that methane is destroyed by high temperatures.

Numerical equilibrium expressions permit of quantitatively indicating the influence of three of the most important variables of a gaseous reaction, *i. e.*, temperature, pressure and concentration. The value of the equilibrium constant increases or decreases with the temperature. Although pressure and concentration variations

do not change the value of the equilibrium constant for a given temperature, the use of such equilibrium expressions enables one to calculate the influence of changes in pressure or concentration for any given temperature. In reactions (1) and (3), there is a decrease in volume due to the reaction; (4), (5) and (6) there is an increase in volume: in (2) there is no change in the reacting volumes. According to the principle of LeChatelier, pressure stimulates those reactions involving contraction; and vacuum stimulates those involving expansion. Pressure and vaccuum are without influence on those reactions involving neither contraction nor expansion.

By a correlation of equilibrium conditions of the various reactions involved in gas manufacture, much help can be had in determining the course of experiments. Unfortunately, equilibrium relationships as shown do not indicate the speed of the reaction, but show the state of affairs after complete reaction has taken place and the system is balanced. Therefore, the information shown by an equilibrium relationship is not complete in itself. No single reaction can be considered entirely by itself. All the reactions in a process are vitally interrelated, though any reaction or set of reactions may be extremely important as indicating a tendency.

The shape of the machine cannot change the equilibrium constant for any reaction. It is easily possible to reach the same equilibrium in entirely different types of machines. The machine is vitally important in so far as its design provides conditions for a favorable or unfavorable equilibrium, or as its design hastens or retards the system in reaching equilibrium. It would be easy to speak indefinitely on the importance and practical application of equilibrium relationships in gas manufacture, but it seems advisable to await further experimental evidence.

In conclusion, I would say that the application of physical chemistry to gas manufacture is stimulating, because gas manufacture is a chemical and chemical engineering problem. It involves solids, liquids, and gases with all the chemical and physical laws governing these three states of matter. The questions of energy and heat transformations determine profit and loss. Nowhere is the questions of chemical equilibrium more important. Vapor pressure, surface tension, solubility, diffusion, disassociation, polymerization, catalysis, decomposition, specific heat, latent heats of reaction, and speed of reaction are fundamentals in physical chemistry, and all are vital to the gas man. The five variables—temperature, pressure, concentration, duration, and contact surface—offer a flexibility which should permit equal flexibility in the character of the end products obtained. Complicated problems become elementary in the light of physical chemistry. The pendulum swings to the extreme where gas manufacture is primarily a problem involving theoretical and applied chemistry. Without its application the industry cannot develop. However, in view of the work recently done and being done, we can feel that gas manufacture as a chemical problem is gradually coming into its own.

Recent Patent Issues.

Prepared for the American Gas Light Journal by Royal E. Burnham, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,119,280. Charging Device for Gas Producers. J. A. Herrick, Newark, N. J.

1,119,312. Process of Separating Gaseous Mixtures into Their Constituents. R. P. Pictet, Berlin-Wilmersdorf, Germany.

1,119,401. Meter System. T. C. Clifford, Pittsburgh, Pa.

1,119,472. Automatic Water Gas Set. J. H. Taussig, Philadelphia, Pa.; assignor to the United Gas Improvement Co., same place.

1,119,569. Gas Burner. H. J. Bubenheim, Pittsburgh, Pa.

1,119,603. Suction Gas Producer Apparatus. P. T. Houston, London, England.

1,119,684. Meter. H. Chrisman, Edgewood Park, Pa.; assignor to Pittsburgh Meter Co., East Pittsburgh, Pa.

1,120,032. Gas Cooking Stove. E. V. Coulston, Cleveland, O.

1,120,219. Incandescent Burner. B. C. Mudge, North Brookfield, Mass.

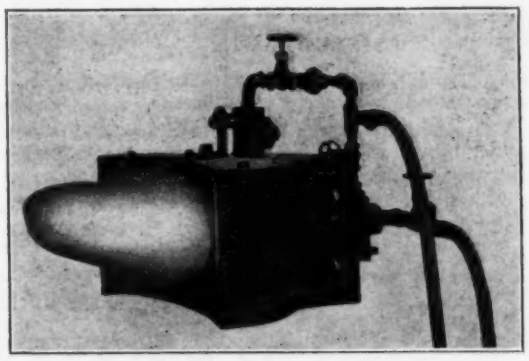
1,120,262. Valve Device for Gas or Fluid Meters. E. V. Anderson, Poughkeepsie, N. Y.

1,120,273. Process and Apparatus for Making Gas. H. Burgi, Springfield, Mass.

1,120,363. Gas Ignitor. R. E. Berthold, Richmond Hill, N. Y.

New Methods and Appliances.

A Portable Sectional Heater for Tires.—A tire portable heater capable of adjustment to suit various sizes of work and applicable to other uses has been developed by the Monarch Engineering Company.



One Section or Unit of Heater.

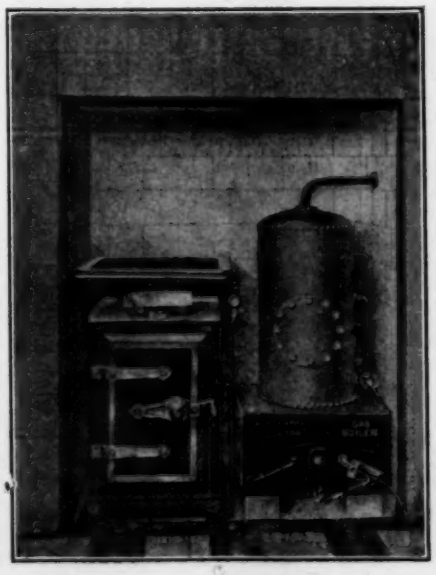
Six or eight heaters are generally required depending on the size tire treated. They are designed for use in railroad shops for truck and engine work, and in blacksmith shops for carriage and wagon tires.

The heaters are of heavy construction and the flame is surrounded by a fireclay muffle. The distribution of heat is even and uniform, and special emphasis is laid on the fact that the use of the heater is not hard on the men doing the work.

Metallic flexible hose is used for conveying the gas and the air for combustion to the heater, and it is pointed out that the use of flexible hose enables units to be removed or added with little trouble.

The Comparative Cost Efficiency of Small Prime Movers.—A contribution by Dr. Strauss to the *Electrotechnische Zeitschrift* gives some interesting information on this matter. Naturally German data are assumed, but the results are sufficiently general to deserve wide attention. In such a comparison it is not easy to take a proper level of load and hours of use, which would be reasonably fair to all of the prime movers tried, but Dr. Strauss's hypothesis of one-third of the time at full load, and two-thirds at half load is perhaps as fair as any other. The size chosen was of 20 actual horse-power with a total use of 3,000 hours per year. As regards cost, the results were in the following order, the minimum being the first named: (1) Producer gas engine, (2) Diesel engine, (3) Ordinary gas engine, (4) Locomobile, (5) Benzol engine, (6) Gasolene engine, (7) Steam engine. The costs varied from about 2 cents per horse-power hour for the producer gas engine to 4 cents for steam. Practically the same order is maintained down to 2,000 hours per year of use. At 1,000 hours the ordinary gas engine and the benzol stand at the top of the list.

English All-Gas-Kitchen Ad.—"A constant supply of hot water can be readily obtained by the use of a Gas Heated Circulator. The accompanying illustration of an up-to-date kitchen shows how neatly the Stove and Circulator can be fixed in the recess once occupied by the kitchen range. The Hot Water Circulator is supplied on hire at 2/6 and 3/- per quarter, according to size, and can be so fixed as not to interfere with existing hot water pipes. The cost of fixing may be paid in four quarterly instalments with the ordinary gas account." It is not an artistic installation judged by our standards.



Items of Interest
FROM VARIOUS LOCALITIES.

AT the banquet of the Pacific Coast Gas Association, in San Francisco, a few weeks ago, medals were awarded for the best papers presented at the last annual convention. Those thus honored were R. J. Thompson, H. R. Basford, B. S. Petersen, C. B. Babcock and H. B. Pitts.

MR. JOHN H. ROEMER, Chairman of the Railroad Commission of the State of Wisconsin, will on February 1st, 1915 join the organization of H. M. Byllesby & Company, of Chicago, in charge of the etensive legal business of that company and its allied interest. Mr. Roemer has served on the Wisconsin Commission since 1907, at which time its duties were enlarged to embrace the regulation of utilities other than steam railways.

ALTHOUGH the National Commercial Gas Associatian Convention adjourned on Friday, the exhibition of gas appliances at the Minneapolis armory remained open to the public until 11 o'clock Saturday night. The Frst Regiment Band gave a concert in the drill room Saturday evening and the show attracted a large number of Minneapolis and St. Paul people.

THE sales force of the Public Service Gas Company, Newark, N. J., formed an association at a "get acquainted" dinner last week. The organization is composed of the outside salesmen and some of the office men. L. S. Platt was toast master, and the entertainment was furnished by the New Business Quartette and others of the members. The following officers were elected: President, A. D. May, Jr.; Vice-President, Albert J. Phillips; Secretary, F. V. Steffen; Assistant Secretary, H. H. Hoile; Treasurer, W. K. Ferris; Trustees, A. J. Keve, Martin Myrnes, T. W. Burtis and L. J. Platt.

THE annual meeting of the Compressed Gas Manufacturers' Association, Inc., will take place Monday, January 18; 1915, at 2:30 P.M., at 25 Madison Avenue, New York city. Besides the election of new officers the meeting will discuss matters of importance to the industry.

MR. JOHN OWENS, who has been Superintendent of Manufacture and Distribution for the Glens Falls Gas and Electric Light Company, Glens Falls, N. Y., is about to take up his residence in Los Angeles, Cal., owing to the ill-health of his wife.

"FIGHTING means perhaps a hundred dollars a month for the families of some men," says George W. Allen, of the Consumers Gas Company, Toronto. "The men receive $1.10 a day from England, and the families receive $25 a month from the gas company and $25 a month from the Canadian Government. If there are children in the family the monthly allowance is greater. Our company at the outbreak of the war organized a riflemen's association. Nearly every employee who could qualify enlisted, and the gas company sent 451 men to the front. When the regulars return from the front their jobs will be waiting for them, no matter if the places were better filled during their absence.

"When the municipal hydro-electric plant started selling Niagara generated electric current at one-half a cent a kilowatt hour, our gas company started fighting for what we thought might be our existence. We fought so well that now more houses have gas than city water, and the householder without a meter connection is fined. We have more subscribers and less invested capital to the square mile than any gas company in America, and both the electric companies opposing us are making money. We charge 70 cents for gas, buying the coal in Pennsylvania and paying duty on it. The company is not permitted to pay dividends greater than 10 per cent. The service department is said to be the greatest in America. If a subscriber living five miles away, who has purchased a 10-cent gas mantle, telephones that he does not know how to put it on, a service man is hustled out there at once to put it on for him. There is no additional charge for such attention."

MANAGER ROSCOE NETTLES, of the Tampa (Fla.) Gas Company, says that "the business of his company for the week ending November 28, showed an increase of 24.54 per cent. over the same week in 1913, and for the previous week there was a gain of 28.57 per cent. Tampa is steadily growing in population and steadily increasing in appreciation of the fact that gas is a great fuel." The company now has more than 5,000 customers, and new consumers are being put on all the time. As an evidence of the "appreciation of gas" of which Mr. Nettles speaks it may be mentioned that the company sells a car load of gas ranges on an average of every four weeks.

THE Business Men's Association of Hempstead, N. Y., held their annual meeting and election of officers last week, and during the business session decided to withdraw the petition to the Public Service Commission regarding the lowering of gas rates, as the Nassau and Suffolk Lighting Company had decided to lower the rate 10 cents. Hempstead people will now get gas for $1.40 instead of $1.50.

THE Canton (O.) Gas and Electric Company are building a 6,000,000 gallon reservoir on North Locust street opposite the gas works, to furnish water for its plants and for the P. & O. Company. By changing the course of the creek and diverting it into an old clay pit, a partly natural depression is made use of. It is the intention to raise the Avenue F road to form a retaining wall on the east; Locust street road is high enough for the south retaining wall; and on the north and west, 10-foot dikes will keep the creek from the reservoir. The water will not run direct into the reservoir from the creek, but it will be filled by pumping such times as there is an abundant supply in the creek. When the supply in the creek is low, water will be taken from the reservoir; at other times it will be pumped from the creek direct.

ASTABULA, O., is fighting a raise in rates for natural gas, and the Mayor has received the following letter:

DEAR SIR:—I understand you are having difficulty in purchasing gas from the present company supplying your city at a price which is reasonable. I am interested in a company that will produce gas and sell you all you want at 22½ cents per 1,000 cubic feet at the plant, and also all the electricity you will want at 3 cents per kilowatt, provided your city will subscribe $75,000 to the capital stock of our company, to be used in the erection of the necessary plant. This stock will bear dividends, which will be 10 per cent or better within one year after the plant is running. If you are interested will be pleased to give you further particulars.

THE bowlers of the office of the Citizens' Gas Light Company, Quincy, Mass., have again started their clean-up system, and last week again took the Post Office employees into camp by a score of 3 to 1. Howe and Muir were tied at 103 for high(?) single.

Gas Office.

LaCroix	102	79	73	254
Nicol	74	88	86	248
Ellard	79	84	83	246
Howe	91	103	98	392
Muir	74	103	79	256
	420	457	419	1296

Post Office.

Hynes	87	80	84	251
Connors	79	90	75	245
Cain	83	76	84	243
Mitchell	109	90	77	276
Joyce	86	90	93	279
	444	426	413	1284

SUPERINTENDENT MEYERS of the Alton (Ills.) Gas and Electric Company, gave the representatives of the patrons of the hot water heating system to understand that "Service" was going to be the watchword of the company of which he has recently taken hold. Mr. Meyers said, not only would the hot water heating service be improved, but the service of the gas and electricity over the city would be brought up to a better standard. Mr. Meyers hopes to make many of the persons who openly declared themselves enemies of the company at the present time, friends before long. His idea of doing this is through better service.

THE employees of the Muskogee (Okla.) Gas and Electric Company, not the least nettled or discouraged by the persistent opposition to the badger fight scheduled to take place in the club rooms over the plant, invited a representative of the Ministers' Alliance to be present at the exhibition on the understanding that upon the decree of the censor will rest the fate of all similar functions in the future. "I have never seen a badger fight," explained Rev. H. C.

Shiffler, the president," "but from what I read I would place it in the same class of brutality as cock fights. I have received numerous protests against the staging of such an exhibition in Muskogee, and will endeavor to either be present or have a representative of the Alliance present to witness the affair."

THE Grand Junction (Col.) Electric, Gas and Manufacturing Company has installed a big coke breaking machine at its gas plant. It is the intention of the company to prepare coke for domestic use. They maintain that the failure of the anthracite mines of western Colorado to produce coal in any quantity this year gives coke a big chance.

MR. GEORGE R. VOGLER has been chosen resident Manager of the Madera (Cal.) Gas Company, to take the place vacated by Mr. John F. Beals, who resigned to go to La Junta, Colorado. The former Board of Directors were re-elected for the ensuing year at a recent meeting of the stockholders, and these elected officers: G.W. Kitchen, President; P. F. Moses, Vice-President; Elmer Decker, Secretary, In accordance with instructions from the State Railroad Commission, a reduction on gas to apply to consumers of over 10,000 feet per month was made. The new rate is $1 per 1,000 instead of $1.25.

A TRANSFER of title to Analostan Island, embracing 75 acres, in the Potomac River, near the Virginia shore, opposite Aqueduct Bridge, has been made by Joseph Leiter to the Washington Gas Light Company. The island will be held by the company for use in the future as a site for a gas manufacturing plant, should development require more extensive equipment. The island was purchased more than a year ago and Mr. Leiter, at that time President of the company, took the title in his own name. In discussing the purchase Mr. Howard S. Reeside, President of the company, said that the property was acquired because expert engineers had pronounced it the best location for a gas manufacturing plant available around Washington, and the only site on which the District authorities would sanction the location of such an establishment.

THE City Council of Sterling, Ills., has passed an ordinance granting certain privileges to the Illinois Northern Utilities Company, and establishing a gas rate of $1.25 per thousand gross, with a discount of 10 cents on bills paid by the 15th of the month. The previous price was $1.35 gross, $1.25 net.

THE Chillicothe (O.) Gas Light and Water Company is contemplating closing its gas plant, for the reason that it has for several years been run at a loss. Since the introduction of natural gas the old company has been losing ground, until now it has but a few consumers left. It is not the intention of the company to abandon and dismantle the plant, but to ask Council for permission to suspend operations under its franchise. In the future a contingency may arise making artificial gas again needed, and the company would then be in a position to supply it. Just when the suspension will be asked for has not yet been decided, but notice will be given to the remaining consumers in time. The company was organized in 1851, but gas was not supplied until 1853, when pipes were laid on Water street from Paint to High, and a lamp-post was erected by private subscription at the corner of High and Water. The record said: "The new illumination is greatly appreciated." As late as 1857 the greater part of Paint street was lit by oil lamps, and it was not for a good many years that artificial gas was generally used.

THE contract for gas street-lighting in Williamsport, Pa., by the Northern Central Gas Company has been approved by the State Public Service Commission.

FIVE thousand employees of the New York City gas companies and their wives, daughters, and friends attended the annuul entertainment and ball given by the Gas Companies' Employees Mutual Aid Society of New York, last week at the Star Casino, 107th street and Lexington avenue. In the audience that witnessed a vaudeville performance were George B. Cortelyou, Robert A. Carter, Walter R. Addicks, Lewis B. Gawtry, W. H. Bradley, George W. Doane, W. Greeley Hoyt, Frank R. Barnitz, William Cullen Morris, George W. Parkhurst, and W. C. Besson, officers of the various gas companies in this city. The society has a membership of more than 3,500.

THE Laclede Gas Light Company has asked the Public Service Commission of Missouri for permission to put into effect Jan. 2,1915,a minimum monthly charge of 50 cents. The company has never made a minimum charge, although the electric light companies have been allowed such a charge.

Utilities Commission News.

EXTENSIONS FOR LONG BEACH, CAL.—A certificate of public convenience and necessity has been granted the Long Beach Consolidated Gas Company by the State Railroad Commission to extend its system into the unincorporated territory known as Bay City. The company had previously secured a franchise from Orange County for the extension.

RATE COMPLAINT DISMISSED.—Holding that the Citrus Belt Gas Company's expected earnings of 7.36 per cent. on its investment was not an unreasonable return, the California Railroad Commission handed down a decision dismissing the complaint filed against the company by the City of Redlands, charging, among other things, that the gas company's rates were exorbitant.

MARYLAND STANDARD HIGH.—The Public Service Commission of Maryland has tentatively fixed standards for the quality of gas in Maryland as follows: Outside of Baltimore city, a single heating standard of 600 B. T. U.; in Baltimore city, a heating standard of 650 B. T. U,, and an illuminating standard of 20.8 candle power. the two standards to apply jointly. In fixing these standards tentatively the Commission says to the gas companies, in substance, that its investigations lead to the conclusion that such standards are proper and calls upon the companies to show cause why they should not be established permanently. The opportunity to so show cause will be given the companies at a final 3-day conference on gas standards, to be held on Wednesday, January 6, and the two succeeding days. In its order the Commission, after fixing the county standard at 600 B. T. U., says:

"It further appearing to the Commission that the inhabitants of Baltimore city and its immediate vicinity, from December 1, 1910, to January 13, 1913, were furnished gas of a normal average heating value of at least 650 B. T. U., and of a normal average illuminating power of at least 20.8 candles, and that it has been fully demonstrated in the past that it is practicable to furnish gas of such qualities with reasonable profit to those engaged in the manufacture and sale thereof; and it not having been made to appear clearly to the Commission that either of said two standards could be dispensed with in Baltimore city at this time with justice to the public, the Commission has therefore caused to be provided in its tentative rules and regulations aforesaid, that until the further order of this Commission, all gas furnished in Baltimore city for illuminating, heating and power purposes, shall have an illuminating power of not less than 20.8 candles and a heating value of not less than 650 B. T. U., and with such exception has caused to be prepared such tentive rules and regulations for uniform application throughout the State."

WHO CONTROLS NEW JERSEY GAS COMPANY?—Ordering the New Jersey Gas Company, in making its report for 1914, to answer according to fact the name of the company through which control, if indirect, is established, the Board of Public Utility Commissioners has entered an order requiring the company to name the concern, if any. which controls its stock. Information in the possession of the utility board indicated that the stock of the New Jersey Gas Company is owned by the New Jersey Consolidated Gas Company.

MASSACHUSETTS APPOINTMENTS.—Governor Walsh sent to the Executive Council last week the appointment of ex-Secretary of State Donahue to the Industrial Accident Board. The appointment, which will become effective January 20th, was confirmed immediately. Mr. Donahue, who probably will be designated as chairman of the board, succeeds James B. Carroll, elevated to the Superior Court bench. The Governor also named Alonzo R. Weed, of Newton, to be chairman of the Gas and Electric Light Commission, vice Forrest E. Barker, deceased. Mr. Weed has been a member of the board for about six years. The Governor made no appointment to the third place on the board.

HOLYOKE, MASSACHUSETTS, REDUCTION.—On application of the Gas and Electric Department of the City of Holyoke, the State Board of Gas and Electric Light Commissioners has authorized a reduction in price of gas sold by the municipal plant from $1 per thousand to 90 cents, accepting the point raised by Manager Kirkpatrick that, even though the 90-cent rate would not clear expenses under the present condition, it is probable that the loss will be made up from the sale of residuals now made marketable by the new machinery at the gas plant and the increase in the amount of gas sold at the reduced rate.

Financial Notes.

PRESIDENT DOHERTY of the CITIES SERVICE COMPANY, in a circular letter to the company's stockholders, says that no immediate change is contemplated in the policy of deferring dividends, although the matter is under constant attention. "We are still of the opinion," he says, "that when the present disturbance is at an end and conditions have become normal, public utility securities will be held in relatively higher esteem than ever before. Apprehensions of depressed business and troublesome times produced by the declaration of war seems to have greatly diminished during the past 30 days."

THE Trustees of the CONSOLIDATED GAS COMPANY have voted to permit stockholders to subscribe on Jan. 8 to the new debentures to the extent of 25 per cent. This privilege applies to stockholders of record Dec. 12 noon. Payments for subscriptions are to be made to the National City Bank and can be made in full or in three instalments. The Standard Gas Light Company, a subsidiary of the Consolidated Gas Company, has passed the common dividend, but declared the regular semi-annual dividend on the preferred stock. Six months ago 1½ per cent. was declared on the common stock.

THE American Trust Company of Boston, in the Federal District Court has brought a foreclosure suit against the ATLANTIC GAS AND ELECTRIC COMPANY, a Connecticut corporation; Calvert Brewer, its receiver, and the Pennsylvania Utilities Company. The plaintiff is suing as the trustee of two mortgages, under which are outstanding bonds to the amount of $3,346,000. The mortgage indentures provide that if there is a default in the payment of the interest the collaterals in the possession of the trustee may be disposed of and the proceeds distributed among the bondholders. The plaintiff states that, to redeem the $1,680,000 bonds of Series A outstanding, there is collateral of the appraised value of $2,241,985. It consists of bonds, stocks, and notes of the Binghamton Light, Heat and Power Company; the Sayre Electric Company, the Eastern Pennsylvania Power Company, the Pennsylvania Utilities Company, the Morris and Somerset Electric Company; the Slate Belt Electric Light, Heat and Power Company; the Nazareth Electric Light Company, the Slate Belt Street Railway Company; the Jersey City, Hoboken and Paterson Street Railway Company; the Chemung Land Company, and the Jersey Corporation. To redeem the outstanding supplementary mortgage bonds of $1,666;000, there is collateral worth $1,584,161. This consists of bonds, stocks, and notes of the Eastern Pennsylvania Power Company; the Binghamton Light, Heat and Power Company; the New Jersey Corporation, and the Pennsylvania Utilities Company.

THE AUSTIN GAS LIGHT COMPANY has filed an amendment to its charter increasing its capital stock from $450,000 to $500,000.

IN response to the request of the PACIFIC GAS AND ELECTRIC COMPANY for tenders of $2,500,000 of its one-year 5 per cent. gold notes, due March 25, 1915, the committee composed of the Bankers' Trust Company of New York, Harris, Forbes & Company and N. W. Halsey & Company, received tenders of $3,751,000 of notes. The company purchased $2,511,000 of the notes at prices which netted approximately 1 per cent. in comparison with the call price of the notes. For September, 1914, gross revenue of the company was $1,444,393, a gain of $85,156 over 1913. Of this gain $47,933 came from the gas department, which had revenue of $562,426, and $44,266 from the electric department, with revenues of $742,484. For the 9 months ended September 30, revenue of the electric department was $6,426,582, a gain of $400,919 over the corresponding 9 months of 1913; while revenue from the gas department was $5,196,803, an increase of $423,995. It will be seen that for both the month and the 9 months the rate of increase was much larger in the gas department than in the electric department. For the 9 months revenue from other departments increased $51,386, and other income decreased $11,728, so that gross revenue of the company for 9 months was $12,730,411, an increase of $864,569. Operating expenses were reduced $357,572, so that net earnings increased $1,222,141.

THE AMERICAN GAS AND ELECTRIC COMPANY has declared the regular dividend of 2 per cent. on the common, payable January 2 to stock of record December 19; and also an extra dividend of 2 per cent. on the common stock, payable in common stock on January 2 to stock of record December 19. Also the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 1 to stock of record January 20. In June the company declared an extra dividend of 2 per cent. in common stock.

CONSOLIDATED gross earnings of UNITED GAS AND ELECTRIC CORPORATION subsidiary companies for the ten months ended Oct. 31, were $23,873,414, an increase of $557,243, or 2.39 per cent. over last year. The small per centage of increase in gross is due to the fact that the electric railway departments made an increase of only 7/10 of 1 per cert. in the ten months, while the gas and electric light and power departments increased their earnings by over 6 per cent. Operating expenses and taxes were $13,931,401, an increase of $289,212, or 2.12 per cent. Taxes increased approximately $139,000, the cost of coal and oil advanced approximately $108,000, while in the wages of conductors and motormen there were advances aggregating $88,000. New contracts recently made for coal and oil will show a considerable saving for 1915. The net earnings were $9,942,013, an increase of $268,031, or 2/77 per cent., while fixed charges were $5,781,321, an increase of $248,681, or 4/50 per cent., leaving the combined balance of the subsidiary properties, applicable to renewals and dividends, $4,160,691 for the ten months as compared with $4,141,341 for the corresponding period of 1913; an increase of $19,349.

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